THE

ELECTRICAL REVIEW.

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THE

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1899

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THE LAW OF NUISANCE.

IN these days when the electric lighting station, as a centre for the distribution of both light and power, is coming more and more into favour, it is sometimes important for those who provide the capital for and build such institutions to know how far the rights of adjoining landowners may be interfered with. Parliamentary powers are often obtained for the laying down of an installation. The privilege—if such it may be termed—of creating a nuisance is granted subject to certain conditions, the main principle throughout being *salus populi suprema lex*. The general public are benefitted at the expense of those, the enjoyment of whose existence is marred by the noise of mighty engines, the whirr of the dynamo, and the ceaseless throb of exhaust steam. Nor does the injury stop short at mere noise and the exhalation of unpleasant odours. Large plant cannot be safely erected without deep excavation for the purpose of laying foundations. The removal of the soil may, and in a gravel district often does, involve the withdrawal of support from the neighbouring tenements, while the mere pumping of water not infrequently produces similar effect. Cracks appear in the walls of houses, doors formerly true grate upon their hinges. Serious injury and inconvenience is caused not only to the occupier but to the landlord, who, in the capacity of reversioner, has a more permanent interest in the premises.

So manifold are the causes which may give rise to nuisance or actual injury, that it is almost impossible for a contractor, however cautious, to complete his labours without giving some ground of complaint to adjoining owners, and when the plant is in working order—when thousands of kilowatts are being generated—those responsible for the undertaking must, however unwillingly, become unpleasant neighbours. How far, it may sometimes be asked, are the promoters and shareholders in an electric lighting syndicate responsible for such damage?

Dealing with the question in the first instance on the broadest lines, we must remember that no man is entitled to use his property in such a manner as to cause injury to his neighbours. *Sic utere tuo ut alienum non laedas* is an old legal maxim which has something more than age to commend it.

A man has a legal right to do what he likes on his own property—a term which includes everything above and everything beneath the land which he occupies—provided he does not interfere with his neighbours' comfort. And this right is not in the nature of an easement—that is to say, it is not a right which is only acquired by uninterrupted enjoyment for a stated period, but it is intimately associated with and bound up in the land itself. So far does this doctrine extend that if a man deliberately *comes to* a nuisance he is entitled to have it abated. Thus, suppose a man purchases a field next door to a gasworks. He becomes entitled to prevent the owners of works from allowing the emission of noxious vapours or

odours which interfere with his comfort. This was laid down by Mr. Justice Byles in Hole *v.* Barrow, 27 L. J. (C.P.), 208. Seeing then that nuisances are regarded with some severity by the law, it remains for us to consider the various kinds of nuisances and the means provided for their suppression.

They may be divided into public and private nuisances. A public nuisance has been thus defined: "An unlawful act or omission to discharge a legal duty, which act or omission endangers the lives, safety, health, property or comfort of the public, or by which the public are obstructed in the exercise or enjoyment of any right, common to all Her Majesty's subjects."

Of this nature is a nuisance created by blocking a highway, or permitting the emission of black smoke from a factory chimney for more than a reasonable period. Outside the class of what we may term public or statutory nuisances, there are a large number of nuisances which can only be redressed by an action at law, wherein the Court may in its discretion grant an injunction or award damages to the injured party, or give him the benefit of both remedies. In urgent cases the Court is often willing to grant an interim injunction shortly after the issue of the writ until the trial of the action.

In the famous case of Shelfer *v.* the City of London Electric Lighting Company, 1895, 1 Ch. 287, an interesting question arose as to the right of the Court to grant an injunction. In that case the plaintiff owned premises next door to the defendants' station. Their excavations caused the foundations of his house to give way to such an extent, that cracks appeared in the walls. When the engines commenced to work, the vibration caused very serious annoyance to the inmates of the plaintiff's house, which was often enveloped in clouds of waste steam. It was proved that his family suffered in health. He sought an injunction to restrain them from so conducting their business as to occasion the nuisances complained of. It was argued on their behalf (*a*) that nuisance was unavoidable; (*b*) that they had taken every possible precaution; and (*c*) that they were empowered by the provisional order to supply electric light to the City of London, and that as they were under a statutory obligation, they could not be held liable for nuisance; (*d*) that the payment of damages would meet the justice of the case.

The provisional order provided (*inter alia*) that the company should be subject to certain disabilities, and should and might do certain things. It also provided for the rights of consumers, and prescribed safeguards for the supply of electricity within a particular area. By Sect. 82, "Nothing in this order shall exonerate the undertakers from any indictment, action, or other proceeding for nuisance in the event of any nuisance being caused by them."

In spite of the strenuous argument of counsel the case was ultimately decided in favour of Mr. Shelfer in the Court of Appeal, of which the present Lord Chancellor was a member, and an injunction was granted in the terms asked for.

In the course of his judgment A. L. Smith, L.J., said:—"If the injury to the plaintiff's legal right (i.) is small, (ii.) is capable of being estimated in money, (iii.) can be adequately compensated by a small money payment, and (iv.) the case is one in which it would be oppressive to the defendants to grant an injunction, damages in lieu of an injunction may be awarded. But there may be cases in which, although these four requirements exist, the defendant by his conduct has disentitled himself from asking that damages may be assessed in substitution for an injunction."

Since the passing of an Act in 1859, generally known as Lord Cairns's Act, it has been competent for the Court of Chancery—and since 1873 for any Court—to award damages instead of granting an injunction. It must not be thought that this Act in any degree detracts from the power of the Court to grant an injunction. The material words are: "It shall be lawful for the same Court, if it shall seem fit, to award damages to the party injured, either in addition to or in substitution for such injunction." The mere fact that the defendants are the directors and shareholders of an opulent company must not be allowed to influence the mind of a judge. While the payment of damage, easily borne by a wealthy corporation, might in the majority of cases meet the ends of justice, there are wrongs which could not be so easily redressed, and for the purpose of suppressing these an injunction must be granted, even if it involves the temporary paralysis of a large industry.

In the Imperial Gas Light and Coke Company *v.* Broadbent (7 H.L.C., 600) the law affecting the right of an injured person to an injunction was very clearly propounded by Lord Campbell. In that case a market gardener obtained an injunction against a gas company who had injured his crops. The Lord Chancellor, after saying that it was a case in which the nuisance continued and had been aggravated, said: "Then, under these circumstances, unless there is something peculiar in this case, it would be a matter of course to grant an injunction. . . . . This is the very case for an injunction, because it is a case in which an action cannot sufficiently indemnify the party who is injured. . . . . Then what is the great inconvenience that is to arise to the appellants? It is said that they have a duty to perform to the public. I consider that this is to be regarded as a mere commercial adventure. They have the liberty to make these works for their own profit, but no indictment would lie against them for omitting to do so; no action could be maintained against them if they could not supply gas."

It will be seen that the plea of "We are public benefactors!" was disregarded in the City of London electric lighting case. While the provisional order allowed the syndicate to pull up the streets and to acquire property compulsorily, the special clause was inserted to protect the interests of the population resident in the neighbourhood of the proposed installation. It has long been an established principle of law that if a person brings something on to his land which escapes and causes damage in the neighbourhood, he must be held liable. Thus the lord of the manor might dam the river running through his park and create an artificial lake. Should the dam burst and devastate the country side, the owner of the lake would be responsible in law. In 1893, this principle, which was laid down in Fletcher *v.* Rylands L. R. 3 H. L. 330, was applied to the electric current. In the National Telephone Company *v.* Baker ((1893) 2 Ch. 186) the question arose in the following manner: The Leeds Corporation under statutory powers introduced the system of electric tramways, which is now such an ornament to their city. As soon as the current commenced to flow it was found that the telephone in certain districts became practically useless. Mr. Macrory, Q.C., who was sent down specially by the learned judge who tried the case, found that while it was sometimes possible to hear with great difficulty, generally speaking the buzzing in the telephone was so great as to entirely prevent the transmission of messages. There was no serious dispute that this was occasioned by the electric current which worked the trams. It was decided that the Corporation would have been liable for nuisance at common law, but the statute under which they had set up the tramway exonerated them from liability.

This case affords a favourable illustration of the way in which our English system of uncodified law adapts itself to the vagaries of a substance so ethereal as the electric current.

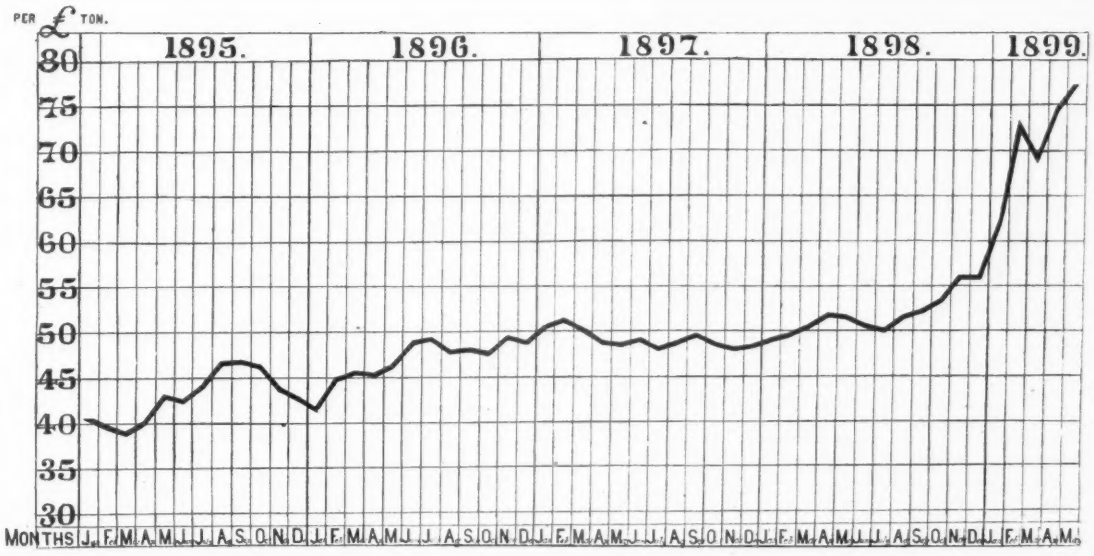
THE EFFECT OF COMBINES IN THE PRICE OF COPPER.

The graphic diagram, prepared by B. H. Thwaite, which was exhibited at the recent Engineering Conference (electrical section), and which we reproduce below, shows clearly the extraordinary rise in the price of copper, due, in a great measure, to the cornering influence of the Great American Combine, which, backed up as it is by the wealthiest financiers in the United States, will be difficult to permanently break. There was a similar rise some 10 years ago, also due to a combine, but the French financier who controlled the combination and tried to corner copper, failed entirely, and the lesson and history of his tragic failure will not be easily forgotten.

One result of this rapid rise in the price of copper is that it emphasises the importance of the adoption of high pressure working for long-distance electrical transmission of energy.

If the price of copper still continues to ascend, it should bring the metal aluminium into the field of active competition.

Is it not pertinent to ask whether the time has not arrived when electrical contractors and municipal engineers should take a firm stand, to combat the evil effects of the cornering policy, and other similar influences, that may prove serious obstacles to the progress of practical electricity?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GOLD, AND MODERN PRACTICE IN GOLD MINING.

Two papers, which refer to the gold industry, were read on the 8th inst. at the Institution of Civil Engineers' section of mining and metallurgy.

There is no mention of electrical applications in the *Modern Practice in Gold Mining*, by J. Hays Hammond; we will say, nevertheless, a few words on this paper, because it is a very clever compendium of mining geology, mining engineering metallurgy and mechanical engineering, which constitute the science of mining.

Mr. J. Hays Hammond is rather severe when saying that there are *very few* mining engineers who are proficient in mining geology, which is their most important province.

The salient factors in the problem of deep mining are the depths *per se*, the ventilation and the drainage.

At present there is no difficulty in hauling through vertical shafts from a depth of 6,000 feet, and a total depth of 12,000 feet could be reached, and the extra cost per ton of ore hauled would not greatly militate against profitable mining, unless the margin between profit and loss had already become a narrow one in the shallow levels.

The author draws attention to the formation in the Witwatersrand, which is unique as regards its reliability, both in respect of the continuity of the ore-bearing formation, and of the payable grade of ore.

Mr. J. Hays Hammond says that there are many miles of reef along the Witwatersrand banket formation, but the Central Rand has been more thoroughly explored than the other sections of the Rand, and he has estimated the value of the gold contents per lineal mile, along the direction of the outcrop of the reef worked down to a vertical depth of 1,000 feet, to be £9,000,000 sterling. The central section embraces upwards of 10 miles, to which the above estimates apply. It seems to us that it would be interesting to have even an approximate idea of what would be the net value of the extraction of these nine millions sterling, after deduction of all expenses for extraction, &c. How much will it shrink, this large block of gold?

For deep level pumping, says Mr. Fearnside Irvine in his *Notes on Gold Mining*, the Cornish pump is not suitable, and electrically-driven pumps are rapidly replacing it.

Their efficiency for moderate lifts may not be so high as that of the Cornish pump, but unlike the latter, it does not decrease with depth, and the cost of installing an electrical plant is so much less, that the interest on capital saved more than makes up for any difference, even at first.

As yet, the steam engine for deep level hoisting has full possession of the field as a motor for heavy winding machinery; but the merits of the electric motor are such, that it should soon begin to displace the steam engine. With the electric motor, wear and tear, and therefore repairs, would be less, and with a proper installation, the cost of fuel also.

Mr. Irvine thinks that no electrical drill has as yet succeeded in supplanting the air drill, and that no electrical pump is handy enough, or, indeed, would stand shaft sinking conditions; but he says that the transmission of power by compressed air is not nearly so efficient as by electricity, and he suggests that ventilation of deep mines should be by an exhausting fan in the upcast shaft, supplemented by electrically-driven fans underground. He also suggests for signalling in many working levels, a combination of the electric signalling apparatus used from the bridge to the engine room on ships, with a separate bell signal arranged on two independent circuits with a common return.

Mr. Irvine says that milling has been much improved, and that the mechanical efficiency attained represents 92 per cent.

In his opinion, the methods of discharging tailings, which amount to 30,000 tons daily, should be as nearly as possible automatic.

We do not quite agree with the author of the paper when he says: "The slimes, after being reduced from 97 parts water

and three solid matter to three water and two solid matter are handled in centrifugal pumps, and pumped in and out of large settling tanks, in which five to six times its weight of cyanide liquor is first added to dissolve the gold, and then, after the gold is dissolved, the cyanide liquor is separated from the solid matter by decantation, and it is the difficulty of effectually doing this which constitutes the *principal trouble in the slimes treatment.*"

The efficient precipitation of gold from the slimes is by far the most difficult operation, and we do not think Mr. Irvine ought to have put under the same heading the precipitation of gold from the slimes solution and the one from the cyanide solution. "This," he says, "is effected by running the gold solution into a tank in which the metal is precipitated by *the electrolytic action set up* by the action *of the solution on zinc shavings*, or by forcing a *current* of electricity through the solution from an outside source.

"The zinc method is the *cheapest*, and has, on the whole, proved itself the most effectual; but no process has yet satisfied all the conditions of cyanide work."

We are aware that a few attempts have been made to precipitate gold from the slimes solution either by the zinc shavings or by the electro-zinc process, but the proof of the precipitation is in the cleaning-up operation, and up to the present the electrolytic process has not been beaten, in spite of the drawback that the companies who use it have to pay a royalty to the African Gold Patents Company, who have the entire control of the electro-deposition of gold in the Transvaal, while there is no royalty to pay for precipitating gold by zinc shavings.

A large electrolytical installation has been started and successfully worked for a few months at the Sheba mine for the treatment of slimes, and the last mail from the Cape informs us that on May 21st last the 50-stamps battery of the Roodeport Central Deep Mining has commenced to crush the ore, and that the cyanide manager has, for winning the gold, an electro-depositing plant, and no zinc boxes.

We have also been told that there is, or there will be, this month, another electrolytic installation started for the treatment of slimes at the Lancaster Deep.

The zinc method is neither the cheapest nor the most effectual, and electrolysis does not lose ground.

CRANES, AND THE POWER TO BE USED WITH THEM.

This was the title of a note presented to the Engineering Conference by Mr. Walter Pitt; we are inclined to suggest that a more appropriate title would have been: "The Power to be Used with Cranes," as it was to the question of power that the author confined himself. Taking in order hand power, steam, electricity, and hydraulics, he pointed out the positions in which each offered the greatest advantage, giving the preference to electricity for overhead travellers, and in cases where a central power station becomes necessary, or where the power has to be transmitted any great distance. After a few brief remarks on hand and steam cranes, the author traced the evolution of the overhead traveller, dividing it into three periods—square shaft driven, rope driven, and motor-driven, the latter being again divided into single-motor and three-motor driving. The single-motor crane, in which a shunt-wound motor runs continuously at constant speed, the various motions being operated by belts or friction clutches, as in the case of shaft or rope driven cranes, received brief mention.

In the three-motor type each motor is geared direct to its own motion, without the intervention of clutches or belts, and the use of series-wound tramway motors is rendered possible, bringing with it the advantage of big starting torque and capability of responding to the driver's views as to speed. Of the various methods of speed reduction from motor to first motion shaft, practically two methods survive, namely, worms and cut gear. The author points out that if properly designed, even a worm will turn, and that if proper coefficients of friction are chosen, satisfactory results will be obtained. For the purpose of controlling three-motor cranes, liquid resistances had been used, but controllers of the tramway type were now coming into favour.

Hydraulic cranes were briefly dealt with, and the author mentioned a novel arrangement designed by himself, in which the lifting gear of a crane is actuated by a Pelton wheel.

In contrasting single with three-motor cranes, we do not consider that the author stated the full advantages of the latter type. In addition to those which he mentioned of big starting torque and wide variation of speed control, we might also point out that as the motors are series wound the large current at starting passes round the magnets as well as through the armature, so strengthening the gap field just at the time when armature reaction is greatest, preventing sparking and preserving the commutator, and as each motor only takes current when it is doing useful work and is geared direct to its work without the intervention of clutch gearing, the efficiency of the three-motor crane is necessarily higher than that of the single-motor type. For the latter it is claimed by some engineers that as the motor runs at an invariable speed, it is not possible for the crane driver to waste time, while the electrical equipment requires fewer spare parts. The constant speed appears to us to be a doubtful advantage, as frequently for purposes of adjustment very slow movement is desirable, while, on the other hand, owing, perhaps, to the non-existence of a trades union among crane drivers, it is not customary for them to run their cranes slow when fast speed is suitable. As to the spare parts, this seems a small matter compared with the great advantages offered by the three-motor type.

As regards gearing, although it is possible to obtain, as the author states, a very fair efficiency with worm gear, such gear if of good quality is high priced, and for a given reduction where space is not limited, cut gear, even if double reduction, will give equal or greater efficiency with lower first cost.

Liquid resistances we can only regard as makeshifts which will drop out of use as soon as a really satisfactory metallic controller is devised, but the tramway type hardly provides a solution of the difficulty, as its action is not sufficiently gradual.

In regard to hydraulic cranes, it is probable that as the crane itself is cheaper than the electric type, while the hydraulic transmission is more expensive than the electric, a combination may be adopted in future, the transmission being effected electrically, while the power is applied hydraulically, as has already been done in the case of boring shields for underground tunnelling where a set of portable hydraulic pumps coupled to a motor are placed near the shield, being moved forward from time to time as the shield advances; current is led to the motor by mains from a generating station on the surface.

THE DISTRIBUTION OF ELECTRICITY.

Mr. Taite's paper at the Municipal Electrical Association meeting deals with one or two changes in the practice of alternating current distribution, which tend to show that the arguments brought forward a few years ago to prove the greater convenience of this method of distribution over the direct current system have lost much of their point. It was said that many distributing centres fed by transformers sunk in holes in the ground secured good regulation and low cost of distributing mains and plant; but now we hear from the author of the paper that this system is being rapidly superseded by the sub-station system with banked transformers up to a capacity of 200 kilowatts or more, and that it is recommended that sub-stations should be above ground. We quite agree with the recommendation, but at the same time we recognise that such a change must greatly increase the difficulties of finding suitable sites for the transformers.

When the demand is not sufficient to warrant the expense of sub-stations, Mr. Taite recommends that the transformer only should be buried below ground, and that the switch and fuse gear should be placed in a pillar-box above ground. This plan is a good one, and we have often wondered that it has not been more adopted for disconnecting boxes in direct cur-

rent systems, especially in those cases where, local authorities being the undertakers, the difficulties of getting permission to erect boxes above the surface are reduced to an almost negligible quantity. The importance of providing an ample number of disconnecting boxes is emphasised in the paper, and these remarks apply equally to all methods of distribution, owing to the great facilities for testing which result therefrom. We do not, however, consider that they are so necessary for making service connections when single cables are used as with a concentric main; as in our experience with single cables, it is not necessary to make the main dead, as only one conductor need be exposed at a time, and therefore, with ordinary care, the chance of the jointer making a short circuit or receiving a shock may be practically eliminated.

The cost of service connections is a serious matter, and so long as it remains as high as £10 to £15, it will always be a hindrance to doing profitable business with the small consumer. It is to be noted that, in the detail statement of cost of a connection given in the paper, the meter and demand indicator together account for £7 out of a total of £11 14s. 6d. The author points out that a gas meter can be bought for £2, and often remains untouched for years, and it is evident that the saving of 6s. on the annual charges which would result if the cost of the electric meter could be reduced to the same figure, is worth striving after. The paper ends with the usual lamentation over the large proportion of the total cost which is represented by capital charges, and municipal engineers are recommended to keep down the capital invested as much as possible, and to build up a reserve fund, instead of paying large sums in aid of the rates. This may be excellent advice for those who have a surplus to dispose of, but we are afraid that the majority of municipal engineers are not yet in a position to profit by it. We would, however, heartily endorse the recommendation not to pay large sums in aid of the rates, as it is manifestly unfair to tax those members of the community who have supported the municipal venture for the benefit of the others who have stood on one side and done nothing to help it.

COMBINED LIGHTING AND TRACTION WORKS.

It is easy or difficult to criticise a paper like that published on another page of this issue under the above title, according as we take into consideration either the intrinsic merit of the paper, or the circumstances under which it is brought forward. Due regard being paid to the latter, one has to check a great deal of the severeness of comments that might otherwise be passed upon the bare merits of the paper as it stands, for obviously a paper intended to arouse a good discussion and bring forward facts from the experience of speakers, serves a very useful purpose—almost as much so as if it contained the facts itself.

Mr. Rider's contribution to the Municipal Electrical Association meeting is of such a nature as that indicated above; he does not really attempt to do more than smooth out a level space on which the members may metaphorically assemble and keep up a lively game with arguments and facts passing from one side to the other instead of balls.

For there *are* two sides to this question, as well as to most amusements, and Mr. Rider admits it to state his belief in the superiority of *one* side—that of combined plants.

His recipe for success is the use of accumulators for storage, and for coping with the peak, and he dismisses with the question, "why not accumulators?" the really complex problem of supply works for a big traction system.

Such a method might perhaps serve for a place like that under Mr. Rider's charge—Plymouth—but for cities of the size of Manchester, Liverpool, Glasgow, and others, he would require to give very elaborate estimates or actual facts before it could be said with confidence that the use of combined plants with accumulators would be more economical and satisfactory than separate stations and additional steam plant for dealing with heavy loads.

We are not in any way opposed to the use of accumulators, they are excellent things for traction work—practically speaking they are essential to it—but we very much doubt whether Mr. Rider could possibly work a big tramway system in a large city from an ordinary type of lighting station plus a large battery—of course, with special traction generating plant. The double peak—from lighting and traction loads—between 5 and 7 p.m. would be so great that his accumulator capacity would require to be at least equal to the maximum tramway output, and the practical tramway manager does not care altogether to rely upon a battery for all his current at a busy time.

In discussing such a question, what is wanted is that figures (exact figures, too) should be given for each case—it is not much use theorising in an elementary fashion—and until we have either very carefully made up estimates, or the actual results of experience in towns of like size and population, it will be extremely difficult for any one to say with accuracy that combined works plus accumulators will give much better results than separate works either with or without accumulators. In spite of what Mr. Rider's opinion seems to be, an enormous amount of difference is made by the size of the town in question, and we shall hope shortly to help elucidate the matter by means of such details as are gradually becoming available by the big towns taking up electric traction.

Mr. Rider, by the way, believes in discounting the future considerably; his classification of towns as possessing separate or combined works includes several with regard to which it is a little premature yet to speak. Manchester, for instance, has not begun to work its tramways yet, and the same may be said of Bolton, Southampton, and Wolverhampton, and Mr. Rider's expression relative to these, viz.:—"What has been decided upon," savours too much, in our opinion, of "the little tin god on wheels" of municipal self-assertion, as though, indeed, whatever a local authority decides upon *ipso facto* becomes law.

Brighton, too, can hardly be brought forward as an instance of a town where combined works are used for municipal electric lighting and a tramway "company-owned." So far as we are aware there is no such arrangement at present existing. However, this correction of detail in his facts cannot be said to affect the principle involved, though it makes a difference to the value of his argument from the mere proportion of combined to total works.

The three points mentioned by Mr. Rider against combined works, and forthwith combated by him, are not of equal value. The first one—that of difference in character of load, is of some, but not the utmost, importance. Although there are on the average tramway system at least four distinct peaks of moderate height in the day (viz., 5 to 8 a.m., 12 to 2 p.m., 5 to 6 p.m., and 9 to 11 p.m.), yet the load may, with the accumulators which Mr. Rider so ardently advocates, be pretty well evened out for the entire day. But if the lighting load is superadded, it makes a very great difference. Either extra generating plant or a battery big enough for the entire evening peak must be added to the lighting plant.

The main argument against combined works, from the tramway point of view, is the second one named by Mr. Rider—that of cost per unit. It seems hardly possible for any combined works to produce current *for the tramways* as cheaply as from a traction power house alone, even when accumulators are employed. The lighting load is economically bound to be a drag upon the traction load, and though the net joint result may be all right from a ratepayer's point of view, yet the Tramway Committee may with fairness ask why their undertaking should be called upon to bear some of the burden of the municipal electric lighting enterprise.

The third argument mentioned by Mr. Rider—that of unreliability—may be dismissed at once as valueless. Important as the continuity of a tramway service may be, that of electric light supply is nowadays still more so, and if the electric light works are capable of breaking down the same thing may happen with even minor consequences in the case of electric traction.

To summarise the question briefly, we do not see very much to be made either way. A combined works certainly saves some amount of land and buildings (though not very much when we consider the space required for battery stations), there is an economy in the staff and management,

and Mr. Rider seems to think that the steam generating plant may be considerably less—which we doubt.

But what is all this worth? For a combined system with extensive traction load, we have, on the other hand, a large outlay on batteries, fully equal to what would be required for generating plant, and the loss in the batteries will almost equal the interest on cost of generating plant standing idle.

At present, it looks as though there were nothing very much in it either way, whilst the advantages of high tension generating plant with transmission to sub-stations (which may quite well have their own regulating batteries) are already proved by actual results with large outputs.

Mr. Rider may be all right in his theory for comparatively small towns, but the big towns and cities are to be dealt with in quite another way.

MUNICIPAL ELECTRICAL TRADING.

Among the papers read before the Bristol meeting of the Municipal Electrical Association is one on the above topic, which its great length precludes us from publishing, from the pen of Councillor George Pearson, chairman of the Electrical Committee of the Bristol Corporation. To name the writer and his office is but another way of saying that the subject is handled with ability, and the conclusion of the whole matter a powerful plea for municipal trading.

It is of the nature of things that Mr. Pearson should look forth on municipal enterprise with the eye of faith. He is able to produce figures, such as that of the investment of 150 millions of money by local authorities during the past 50 years in public works, with fairly profitable results financially, and undoubted public benefit. He is able to come before his Bristol audience and point to a sufficiently gratifying issue of Bristol's venture into the field of electricity supply. To argue from these premises that municipal trading is good, and should include in its scope electrical enterprise, is but a natural step. With the former thesis we concur in part, with the latter we join issue.

We think it would clear the way to a better understanding between the "municipalist" and "individualist" schools if they could bring themselves to see with Mr. Pearson, that municipal trading has its proper uses and its natural limitations. He says, and the view is noteworthy having regard to its source:—"I think municipal trading should be confined to the provision of those necessities of civilisation which are so large as to be beyond the power of individual effort to supply, and which do not form part of any Government department. The effort of the individual will generally produce more economically than either a company or a local authority; but as between a company and a local authority there is, economically speaking, very little to choose." This very fair *exposé* of a sturdy municipal advocate's position narrows the straggling maze of controversy to clear and well-defined paths.

In the first place it disavows the title of the more ardent municipalist to start on a career of municipal manufacture—a right, it will be remembered, sought by 70 local authorities in the last session of Parliament in regard to dynamos, motors, and other electrical apparatus, and very properly refused. We imagine no sensible person contends that the manufacture of electrical apparatus is "beyond the power of individual effort." We believe Mr. Pearson's views are or will come to be shared by the majority of thoughtful ratepayers, and that we shall hear no more of municipal electrical manufacture.

In the next place it tempts us to turn upon Mr. Pearson the weapon he himself forges, and to retort that the good results at Bristol are less a justification of municipal enterprise than a tribute to the "individual effort" of a capable business man acting as chairman of the Electrical Committee. For it will be found on analysis of the figures accompanying Mr. Pearson's paper, that while municipal enterprise has fairly justified itself in certain fields, in that of electricity supply it presents as a whole an unprofitable showing when debited with charges of an administrative character and with depreciation, such as would appear as a matter of course in the profit and loss accounts of private enterprise. We need not quote specific instances in proof of this, which are numerous and of common knowledge.

Mr. Pearson's quarrel is thus not with individual enterprise, for which he advocates preference, but with that of the public company, which for various reasons he deprecates as contrasted with municipal effort in the same fields. We find ourselves unable to follow his conclusion; and this mainly on the broad public ground that the operations of a company are subject to the stimulating effect of competition, while those of a local authority are not—at any rate at present. Every student of economics and history knows what this means and whither it leads. We give Mr. Pearson the credit of implicitly appreciating this also, for he says:—"All that municipal traders ask is a fair field and no favour. Let us have no artificial supports to municipal trading, indeed, let us have no supports which are not given to companies under similar circumstances."

This is common ground on which all moderate men may meet and agree. But, unfortunately, it is the voice of a municipal Daniel crying to ears of a hitherto deaf majority of extremists; for these claim that private interests should not, while a local authority should, be protected by monopoly when undertaking electricity supply for light or traction. This outrageous contention was at the root of municipal opposition to the electric power distribution proposals of last year. The debate in the House of Commons on this question gives evidence that independent men are beginning to appreciate the issues at stake, in spite of the unsteadying pressure of municipal caucuses.

Mr. Pearson states his reasons for preferring municipal to public company enterprise, which consist generally of a summary of the undesirable practices to which less scrupulous company administration is prone. These we are the last to deny; and join with him and all others who desire to see the path of the evil-doer strewn with difficulties. But to condemn company electrical enterprise in general because there has been some trafficking in powers, is, in our view, to overshoot the mark, because such instances have been remarkably few in this country, and under our system have a gratifying tendency to recoil on the promoter's head. Mr. Pearson also, we regret to observe, descends from principles to persons, by making an attack on the leaders of the "individualist" or "private enterprise" campaign. The dissection of motive is a dangerous practice, and liable to undo the operators unless their own hands are scrupulously clean. We have heard it suggested by many men who are in a position to express an opinion, that the fervour of the municipal faith is not wholly dictated by disinterested love of one's fellow ratepayer, but contains a less ethical element in the form of increased Parliamentary and other fees for town clerks, enhanced importance and remuneration for borough engineers and electricians, and pleasant little excursions to London and the Continent for electrical committees.

But we prefer to leave the unprofitable atmosphere of personal recrimination, and to return to the main theme of Mr. Pearson's temperate and clearly thought-out essay, from which both sides have much to learn. To the anti-municipalist who is still so narrow-minded as to decry local-authority enterprise of every description, his figures afford in certain respects a crushing reply; while to the fanatical municipalist whose articles of faith are summoned up in the commandment, "Corporations first, and the rest nowhere," we earnestly commend the foregoing conclusions of one of their leaders of proved ability, to the effect that (*a*) individual should have preference to municipal enterprise; and (*b*) if both are in the running, a fair field and no favour to either.

THE INSTALLATION OF STEAM BOILERS.

II.

(*Continued from page* 973.)

Material.

The modern steam boiler has but one material of construction, mild steel made on the open hearth system. We need not say much of open hearth steel further than that it

is made by two processes, the acid and the basic, so called because the furnace lining is siliceous or calcic. The first, or acid process, demands a raw material free from phosphorus, for it is not fitted to remove phosphorus, the most dangerous impurity steel can possess. In the basic process phosphorus can be removed, and this process enables cheaper grades of phosphoric pig to be employed. Certain failures of basic steel have occurred to cause hesitation in its employment, but there is no reason why basic steel should not be equally as reliable as acid steel when made by open hearth process. For shells exposed to tension the quality of steel is such that its ultimate strength should be from 55,000 to 65,000 lbs. per square inch of cross section, the elastic limit 33,000 to 44,000 and the extension when broken 25 to 30 per cent. in 8 inches, the

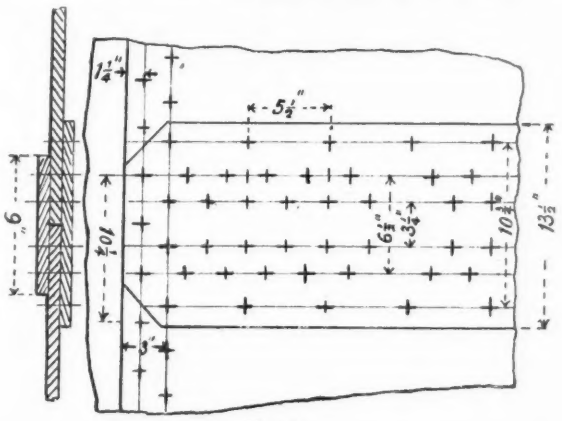


Fig. 1.

reduction of area at the point of final rupture being 50 to 60 per cent. For furnaces exposed to compressive stress the ultimate strength may be 50,000 to 60,000, the elastic limit 30,000 to 40,000, the elongation 25 to 30 per cent. in 8 inches, and the reduction of area 50 to 65 per cent.

The following table gives some results of tests made for the writer on steel plates for a boiler:—

Use of plate.	lbs. per sq. in.	Elongation in 10".
Shell	64,960	23 per cent.
"	63,960	23 "
Ends	60,480	24 "
Flue tubes	59,800	25 "
"	60,480	24 "

These limits provide for the ductility which is the most important quality of boiler plate, and is not only essential in the process of flanging, but also ensures longevity with safety. Rivets may be of softer steel.

Good boiler steel should have less than 0·04 of phosphorus in its composition, and not over half this amount of sulphur. Carbon is contained to about 0·16; manganese to

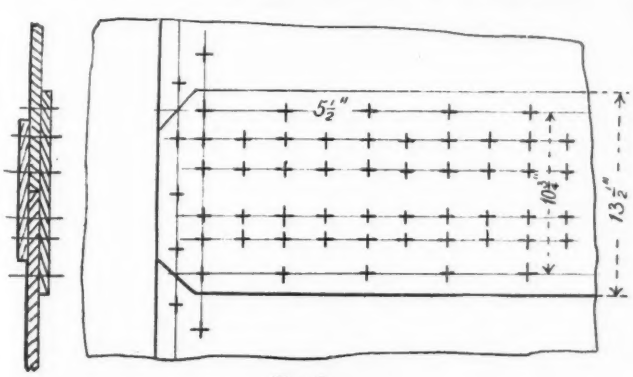


Fig. 2.

0·50. Manganese counteracts sulphur. Phosphorus reduces ductility, and is thus very undesirable in steel which is to be flanged.

Steel plates can be now bought of such size as to enable a boiler shell 9 feet diameter by 30 feet long to be built up of four plates only.

The standard size of boiler now used measures usually 8 feet diameter and 30 to 32 feet long. For a pressure of 150 lbs. per square inch the shell plates will have a thickness of $\frac{11}{16}$ inch, the end plates of $\frac{11}{16}$ inch to $\frac{3}{4}$ inch, the first and last furnace tube plate $\frac{5}{8}$ inch, the remainder $\frac{9}{16}$ inch, while the stay gussets will be of $\frac{9}{16}$-inch plate. The above thickness of shell would be insufficient without proper care of the riveting, which will be treble with double butt-straps as per fig. 1 or fig. 2, which represent alternative systems of riveting. The object of the third row of rivets at double spacing is to reduce the proportion of plate cut away by the rivet holes. With properly proportioned joints the percentage of strength of the joint to the solid plate is measured by the ratio of the distance between the rivet holes to the distance

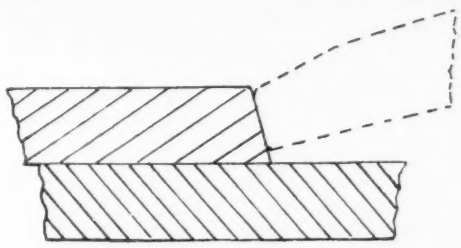


Fig. 3.

from centre to centre of the same. Thus with a pitch of 6 inches and a rivet hole of $\frac{7}{8}$ inch the ratio is 41 to 48, or $(6-\frac{7}{8})$ to 6 = nearly 85½ per cent. It is stated by the Manchester Steam Users' Association, however, that the calculated percentages of strength are not secured in actual joints. Needless to say every hole in a boiler should be drilled in position. This can be done. After drilling the plates are taken apart and the burr caused by the drill is removed. When again put together the rivet holes should come fair to each other. In riveting up the rivets are not put in next to one another, but a length of seam, particularly when circular, has first inserted in it rivets at opposite diameters, then at other opposite diameters, so that any possible slackness between two rings of plate will not be all run together but distributed round the whole circle. Before rivets are inserted it is usual to draw the rivet holes fair and opposite by means of a steel taper pin. When all the holes have been drilled in place the stress necessary to be thus exerted upon the plates is very trivial and must not be confounded with drifting, which is an intensified variety of the same process applied to plates which have never been truly punched. In addition to the drilling of holes the plate edges are also planed to an angle of about 15° as per fig. 3, and when put together and riveted up the joints ought to be tight. This is rarely the case, and means are taken to make them so. The common method is to caulk the joints inside and outside the boiler with a narrow tool. The practice is bad in two senses. The narrow tool drives the plates apart and

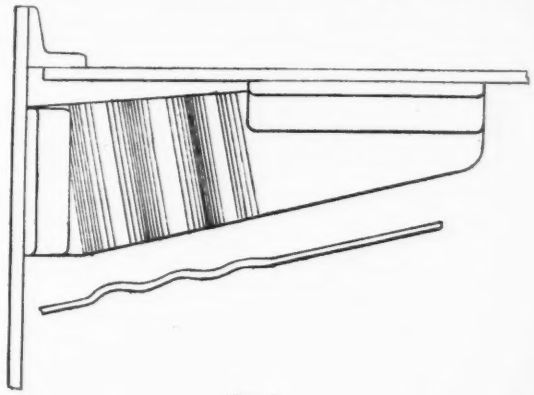


Fig. 4.

injures the surface of the lower plate and causes corrosion to be more easily set up. In the first place only a wide tool or fuller ought to be permitted, as shown by the dotted lines in fig. 3, and secondly, no work of this description should be

allowed upon the water side of a plate. With the planed edge and wide tool of fig. 3 the upper plate is simply swelled generally against the lower plate, and any openness of joint closed thereby. As no longitudinal rivet seams can be allowed below the water line, it follows that the longitudinal joints of the single plates which form the shell must be placed alternately left and right between the water level and the vertical centre line. The most delicate part of a Lancashire boiler is the end plate, for, if not carefully constructed, there is always danger of corrosive grooving of the end plate round the upper edge of the furnace attachment angle iron or flange, or of the root of the angle itself. This was a common occurrence when end plates were made very stiff. The heat of the furnace causes the flue tubes to lengthen and to camber upwards, and these two actions combined thrust outwards the top edge of the furnace angle ring attachment and throw great stress on this and the plate. It was perceived that this action was most severe where the gusset stays were most rigidly attached to the plate, and a certain area or breadth of unstayed plate was found to be necessary. At the present time there is a distance of 10 inches allowed between the lowest rivets of the gusset stay angle irons and the outer ring of rivets attaching the furnace tube to the front plate. The gussets being flat plates have no elasticity of form, and hold the end plate very rigidly where attached to it.

The writer is not aware of it ever having been done, but it appears to him that a desirable elasticity would be obtained by pressing the gusset plates into a series of flat corrugations as in fig. 4. Experiment would probably be required to show how far the system would be useful, and to what extent the plates should be corrugated, the corrugations, of course, diminishing to zero at the edge next the shell, their object being to spread the movement due to expansion over the whole surface of the plate, so as to diminish the intensity at any locus. The amount of corrugation might also be calculated. Obviously, any boiler maker could arrive for himself at a suitable proportion by commencing in some one boiler with very slight amounts, and carefully noting behaviour on test, and slowly increasing the amount for subsequent boilers until he arrived at sufficient and satisfactory elasticity. So far a perfectly satisfactory elasticity has not been found; it cannot be found with an absolutely straight and flat gusset stay.

It will be noticed that the first ring of the furnace and the back ring of the flue are made stouter than the remainder of the furnace tubes. This is because of the stress upon these rings at the end plates, and it is considered better to thus use stouter plates than to use an additional angle ring over the connecting flanges. It should also be explained that the connection of the front end plate to the shell by an outside angle ring while the back end plate is flanged or otherwise connected inside the shell, is due to the necessary elasticity sought in the front end, more particularly with room for a sufficient number of rivets which can be secured at the back end by reduction of the diameter of the tubes to the extent of 6 inches.

The arrangement of gusset plates is such that at the shell they are spaced an angular distance apart such that the arc between them is about a fourth of the shell diameter. The shell plate which carries the manhole mouthpiece is usually made double to provide the strength lost by the gap. Manhole mouthpieces are best of cast-steel or pressed out of steel plate, and their internal diameter of 16 inches is fixed as one that will permit the easy entrance of a man. Similarly, the mudhole mouthpiece is made 15 inches × 11 inches inside to permit of fairly easy entrance.

Both where attached to the end plates, and to the shell the gusset stays are made a close fit between their containing or attachment angle irons and are secured by properly closed rivets.

Being in compression the furnace tubes were for long the weak portion of a boiler. The means taken to strengthen them were rings of angle or tee iron or Bowling hoops, but all these gave place to the Adamson flanged seam. This seam appears capable of affording, according to its spacing, any desired strength to a tube, and is still employed for the highest pressures, though corrugated and ribbed plates are much used in marine work. The flanged seam has a great virtue in that nowhere is more than normal plate thickness exposed to flame. Some boiler makers consider that tubes are stiffened by welding in cross water pipes. It is doubtful if they even strengthen the rings of plate in which they are placed. Even if they do they add no strength to the furnace which really most requires strengthening. It has been shown that they do not facilitate circulation, while it is certain they cause smoke and prevent thorough cleaning of a boiler. They ought never to be employed.

(To be continued.)

THE THEORY OF THE WEHNELT INTERRUPTOR.

Dr. B. Walter, of Hamburg, who is well known in connection with investigations into the theory of the induction coil, contributes to the *Fortschritte auf dem Gebiete der Röntgenstrahlen*, Vol. II., an interesting article which throws new light upon the action of the Wehnelt interruptor.

It is a favourite theory among scientific men that the peculiar action of this interruptor depends on resonance. It has been supposed that the gaseous layer developed on the anode acted as a condenser of considerable capacity; and this, combined with the self-induction of the primary coil, supplied the conditions necessary to generate electric oscillations in the circuit. This view is proved to be erroneous, in Walter's opinion, by the fact that hydrogen only is set free on the cathode. If oscillating currents really existed in the circuit, we would expect to find a mixture of oxygen and hydrogen on the cathode.

On the other hand, Walter found by means of the spectroscope that both oxygen and hydrogen were developed on the anode. This led him to formulate the following theory. When the current first begins to flow, bubbles of oxygen are formed on the anode. Then the temperature rapidly rises till a layer of steam is formed round the anode. This is sufficiently non-conducting to cause a considerable reduction of current. The self-induction in the primary coil thereupon produces a considerable increase in E.M.F.; the layer of steam is electrolysed into a mixture of explosive gases and finally exploded by a spark. The explosion drives the liquid completely away from the anode, and produces thereby a complete momentary cessation of the current. The current is, however, always unidirectional, never alternating. The presence of self-induction in the circuit is necessary to obtain sufficient E.M.F. to electrolyse the steam and explode the mixture of oxygen and hydrogen.

Walter considers that the construction of the present induction coils will have to be considerably modified to get the best results with the Wehnelt break. The thickness of the wire in the primary and secondary coils will require to be increased to prevent overheating; and better insulation will be necessary, since the extremely rapid breaks produce a tension in the coils which is almost electrostatic. Another important point is that the primary coil should be tuned to the break, *i.e.*, for each break there is a definite self-induction in the primary which gives the best results.

The Wehnelt break should be made so that the length of the platinum anode, which projects into the electrolyte, can be readily adjusted. The platinum wire is, for this reason, made to slide in a glass or porcelain tube. The length of wire which projects from the end of the tube can be regulated by a screw or other suitable adjustment. For every tube and induction coil there is a certain length which gives the best result. As a general rule, for soft tubes, the length should be shorter, and for hard tubes longer. In practice, however, it is best to commence with a short length, say, 1 mm., and gradually increase this till the best result is obtained. The magnitude of the current which produces the explosive break increases as the length of the platinum increases; and the theory of the induction coil shows that the tension in the secondary is proportional to this breaking current and the suddenness of the break. The frequency of the breaks is reduced by increasing the surface of the anode, but not to such an extent as to neutralise the effect of the increase of the breaking current.

As already mentioned, one of the most important conditions for the successful application of the Wehnelt break, is the use of a primary coil with a definite self-induction. The primary coil which is best suited for the ordinary break,

does not, as a rule, give the best results with the Wehnelt. For instance, Walter found that the Wehnelt break on his 50-cm. induction coil gave a spark of only 10—12 cm.; but when the ordinary primary was replaced by the primary of a 30-cm. coil, the effect was tripled. Walter recommends that every induction coil should be supplied with an extra primary coil specially designed for use with the Wehnelt break.

The breaking current in the primary to produce a given length of secondary spark is much greater than with the ordinary break. From this it may be inferred that the output of a coil per unit of energy supplied is not so great with the Wehnelt as with the ordinary break. The output per unit of time, or what may be called the horse-power of a coil, is, however, immensely greater with the Wehnelt.

These investigations of Walter's may be of considerable value in increasing the efficiency of Röntgen ray apparatus in which the Wehnelt is used. Walter has obtained a Röntgen photograph of the pelvis in 10 seconds, and he thinks that this time may yet be considerably reduced.

THE REPORT OF THE PACIFIC CABLE COMMITTEE.

(*Continued from page* 969.)

BESIDES the General Report of the Committee which we concluded last week, another Report dated London, December 16th, 1896, was furnished to the Canadian Minister of Trade and Commerce by Sir Sandford Fleming, who was present during the examination of all the witnesses in the Colonial Office. This Report is not appended to the English Blue Book, but will be found on page 73 of the Canadian Blue Book, "Documents Relating to the Proposed Pacific Cable," Ottawa, [No. 51, 1899] issued on May 1st of this year.

We now propose to deal with the subjects on which evidence was collected by Lord Selborne's Committee:—

I. Is the laying of such a cable practicable from a technical point of view?

To judge of this it was first necessary to have information concerning the depth and nature of the bottom of the Pacific Ocean in the area through which the projected cable would probably pass.

At the inception of the Pacific cable scheme the information on the subject, although considerable, owing principally to the soundings obtained by the *Challenger* and the United States s. *Tuscarora* was still so incomplete as to permit the opponents to the Pacific cable scheme to refer in the Press and elsewhere to the "vast and unexplored depths of the Pacific," and to allow the late Mr. Patey representing the Post Office, when giving evidence before the London Conference, 1887, to state that depths of 12,000 fathoms were found in the Pacific Ocean, a statement which also appears in a minute supplied to the South Australian Government by Sir Charles Todd, the Postmaster-General for that colony; needless to say, nothing approaching such a depth has ever been found in any ocean.

Since the Ottawa Conference in 1894 recommended a further survey, this work has been carried on, at first intermittently, but lately almost continuously, by the Hydrographical Department. The soundings thus obtained are reinforced by the excellent lines of soundings made by the United States Government in 1892 from California to the Hawaiian Islands, preparatory to the laying of an American cable to connect these places. This survey took three months to make, and over 500 feet deep water soundings were taken.

As regards the Pacific Ocean generally, we have now some 1,950 soundings over 500 fathoms in depth, which relate directly to the route along which it is proposed to lay the cable, and there are altogether some 500 more, which throw some considerable light on the subject. It has been generally admitted in evidence that nowhere along the line is the depth much greater than that in which cables have already been laid and picked up, the greatest depth being some 3,200 fathoms, but the general average being considerably less. Mr. Lucas, although he considered the Pacific Ocean "a very favourable place for a cable, and a place where a cable will probably have a long life when once laid down," drew attention to the danger of shallow patches or of deep holes which might be encountered, a local depth up to 5,155 fathoms having been found.

Attention was also drawn to this point by the representatives of the Eastern Extension Company, but Sir Sandford Fleming's evidence shows that this local depression is many hundreds of miles off the cable route, lying, as it does, to the east of the Kermadee Islands, and 600 miles north-east of the northern point of New Zealand. In reference to this depression, Admiral Wharton, after giving his reasons for such an opinion, said: "I should not expect to find these very deep soundings on that long route," referring to the Vancouver-Fanning Island section. To the south of Fanning the soundings are already sufficiently numerous and well distributed to show that there is no likelihood of any such local depression existing in that portion of the route. Another such local depression is found in the Atlantic where 4,561 fathoms is met with within about 60 miles of two cables which were laid respectively in 1870 and 1871, and which are still working well and free from interruption.

Sir Saul Samuel managed to extract evidence showing that as far as the distribution of coral is concerned, the Pacific is very much freer from such danger than the route followed by the present cables to Australia; it was pointed out by Mr. Herbert Taylor that "the Red Sea is full of coral, the first cable lasted many years very well." There are no less than four cables forming part of the Eastern Telegraph Company's system which pass through the coraliferous Red Sea, and these seem to be not much more subject to interruption than any other portions of this company's cables. It was also shown that for several hundreds of miles the Eastern Extension Company's cables to Australia lie in shallow and coral-floored seas.

As to the completion of the survey along the Vancouver-Fanning Island route, this should not take much more than three months, if it were undertaken in the same way as that adopted by the American Government in making the survey between San Francisco and Honolulu, and we understand that H.M.S. *Egeria* has been told off to do the work.

We are astonished to notice in Admiral Wharton's evidence that sounding operations are not carried on continuously during the 24 hours on the vessel engaged in this duty. As to the possibility of laying a cable between Vancouver and Fanning Island, none of the witnesses examined dispute the practicability of this, although varying opinions were expressed as to the size of core which might be necessary; but this latter point we will deal with under the heading of revenue.

As regards the landing places, it is to be regretted that this country long ago sacrificed her opportunity of taking over the Hawaiian Islands, which would have formed a convenient and important station on this route. In referring to Fanning and Palmyra Islands, Admiral Wharton draws attention to the steepness of the slope, but in Mr. M. H. Gray's evidence no difficulty is anticipated on this account. It is generally admitted that the bottom of the Pacific is soft, and of a kind favourable to the life of a cable; it is also stated by several of the witnesses that the depth of the water is a distinct advantage as far as concerns the durability of the cable.

With the general question of durability of cables we will deal later on.

As far as concerns the possibility of laying a cable of a class suitable for the Vancouver-Fanning Island section, some of the witnesses have, in our opinion, rather too readily assumed that a cable such as that laid across the Atlantic for the Anglo-American Telegraph Company in 1894 (having a core of 450 lbs. of copper and 400 lbs. of gutta-percha per nautical mile) is the extreme possible limit of size and weight. This opinion seems mainly to be founded on the fact that this cable is the largest which has hitherto been laid; and also that, as pointed out by Dr. Muirhead, the laying was not achieved without trouble.

The difficulty is reported to have been due to "the stiffness of the conductor"—the conductor in this case was made up of a layer of copper wires of small gauge, surrounding a very large central copper wire, and it is easy to understand that the knuckling of a thick non-elastic wire under bending

or other strains is a disadvantage, inasmuch as it tends to the decentralisation of the conductor when a straight pull is put on the cable.

Whether, however, the difficulty experienced was due either to the defect inherent in such a type or to insufficient brake power is not of great importance, as this special style of core need not necessarily be regarded as limiting the possibilities of cables made up in other ways.

To sum up the evidence given as to the technical practicability of laying this cable, the matter seems to be beyond question perfectly possible, and we are quite in agreement with the opinion expressed in the report of the committee on this division of the subject.

(To be continued.)

THE INSTITUTION OF CIVIL ENGINEERS' CONFERENCE.

ECONOMICAL TRANSMISSION AND DISTRIBUTION OF ELECTRICITY FROM A DISTANCE.

By Horace Field Parshall, M.Inst C.E.

In introducing for discussion so broad a subject as the economical distribution and transmission of electricity from a distance, only a very general statement is possible, since local conditions cause widely different conclusions to be arrived at in different cases.

The subject may be sub-divided into:—(1) Economical generation; (2) economical transmission; and (3) economical distribution.

1. *Economical Generation.*—There is not much to be said on the subject of economical generation, if the electrical conditions alone are considered, since the difference in efficiency, cost, and maintenance between types of generators, whether continuous current, alternating current, or multiphase, is but small.

In dealing with multiphase transmission, there may arise conditions where the use of step-up transformers will be found more satisfactory commercially than the use of generators working at very high pressure.

2. *Economical Transmission.*—In the transmission lines, so far as the cost of conductors is concerned, and the efficiency in transmission up to the commercial limit of cost of generating or transforming apparatus, there is a direct gain in increasing the voltage where overhead lines are permissible. Where underground cables have to be considered, with the present knowledge of cable making, it may be said that 20,000 volts is the safe limit.

3. *Economical Distribution.*—This has to be determined with reference to the conditions to be maintained in the consumer's circuit. These conditions are, as to whether continuous or alternating currents are most adaptable for a particular set of local conditions, or whether the combination of both could be made to meet the widest range, and, finally, what conditions as to voltage drop have to be maintained. Either for lighting, or in earth returns for electric traction, a very small voltage drop only is permissible.

A number of small electric sub-stations will, from a commercial point of view, be found more economical than would be the case if each were to be a complete generating station. Sub-station plant can be built free from objectionable vibration or noise. It also occupies exceedingly little space. For these reasons it can be located in situations which would be impossible if complete generating stations had to be laid down.

Numerous sub-stations involve lower efficiency in transformation, higher first cost of plant, and heavier attendance charges. On the other hand, a saving is effected both in feeders and distributors, and the efficiency of transmission is increased, due to smaller feeder losses. Any general rule as to the most economical number of sub-stations to employ is impossible. For a particular case of fairly uniform distribution over a large area at a rate of 1,000 kilowatts or more per square mile, a radius of distribution of half a mile would be warranted from economical considerations.

Smaller supply densities and in general ununiform distribution will increase the economical radius of supply, and diminish the best number of sub-stations.

With short feeders the further advantage is obtained that the feeder drops are smaller, and the consequent variation of voltage at different parts of the system through different feeders loading up irregularly is largely eliminated, with consequent simplification in switchboards, better service, and more economical running of the plant.

The arrangement of sub-stations has also to be considered in respect to the nature of the load, so that, in the case of the average load, the losses due to friction and hysteresis will be balanced against the C^2R losses.

In general, it may be said that single-phase transmission has had its day. In any scheme, even though designed primarily with a view to lighting distribution, it becomes necessary to take into account probable demands for power. So far, the single-phase motor has not been a success, and in districts where single-phase plant has been laid down, special arrangements are being generally made for the supply of continuous current for power purposes.

The gradual perfection of the generating apparatus, so that current can be obtained reliably at very high voltage, the high efficiency of the transmitting mains, together with the step-down transformers and rotary converter, and the great flexibility of such system, has led many engineers to believe that multiphase transmission with rotary converters and continuous current distribution will be the ultimate system in dealing with large powers over any extended area. The popular formula amongst the more progressive engineers is to use multiphase transmission at a periodicity of 25 to 50, at from 5,000 to 40,000 volts, according to the distance and conditions of transmission.

There is comparatively little choice between two or three-phase currents. The conditions favouring three-phase transmission are in respect to the small amount of copper required, and greater flexibility in the use of transformers. Thus, without increase in complication, the three-phase system requires but three-quarters of the weight of copper necessary for two-phase currents, and the transformers may be connected for six-phase transformation instead of three-phase in dealing with rotary converters—a condition very favourable to practical working.

The theory of the action of the rotary converter has been definitely laid down, and there is at the present day plenty of experience as to its working in practice. The early difficulties experienced have been largely overcome by more careful design, both in the prime mover and in the rotary converter itself. It has been found necessary to give attention to the production of constant angular velocity in the prime mover.

In England, on account of the stringent regulations in connection with the working of tramways, multiphase currents become economical at less distance than in most other countries, since the losses due to transformation are compensated for by the advantages gained by centralisation. The only two notable multiphase installations in the United Kingdom working are those of Dublin and Middlesbrough. There are, however, the greater installations of the Central London Railway, the London United Tramways, and the Glasgow and Metropolitan. When these are completed, it can be fairly said that these installations demonstrate the general feeling amongst engineers, that the multiphase system of generation is the one most likely to give economical results, even over comparatively limited areas.

In the absence of the author this paper was read by Mr. Crompton.

Mr. Thos. Parker said that there was very little definite information in the paper. He himself thought that there was no need to use three-phase currents, as his firm were quite prepared to build direct current machinery up to 2,500 volts, and he thought it would not be difficult to build them for 5,000 volts. It was objectionable to have a plant which required synchronising.

Major Cardew said that with respect to difficulty of synchronising, it might be best to generate at high pressure direct and change to three-phase by transforming up for the feeders only. For two-phase work four conductors would generally be needed, as with three wires the angle between the phases was unequal.

Mr. Crompton thought the subject very fascinating. He agreed with Mr. Parker to a certain extent, but there were limitations. He was prepared to tackle direct current work up to 2,000 volts, but what about electrolysis. His friend and late works manager, Mr. Hayward, who was now in the United States, kept him well posted up; he had carried out a plant for the Telluride Company at 40,000 volts, and 20,000 volts was used on the Continent. Generators could be wound direct for 20 to 25,000 volts, 500 kilowatt machines were being built up to 10,000 volts, and 700 kilowatt machines from 15,000 to 20,000 volts. The percentage of failures is lower than with low pressure plant in England. Why should not three-phase current be used right on to the motors themselves on the trams? Mr. Brown did this with a double trolley.

Mr. Owen said that the New York Elevated Railway were putting down 16 4,000-H.P. machines, and these were wound direct for 10,000 volts; underground cables were being laid all over Manhattan Island, and a frequency of 25 periods was adopted.

Mr Wilson thought that there would be considerable difficulty in synchronising with polyphase machines, especially if the machines were driven by steam engines with early cut off.

Mr. Mavor, referring to synchronism, thought that possibly the speed of the engine might be varied.

Mr. Hammond thought that lighting was now a very small part of the problem of electrical engineering. He noticed that the author advised sub-stations, but in Hackney he had 17 feeding points, and he would strongly object to have moving converters at such a number of points. There might be difficulties in putting two-phase machines into parallel, but doubtless it would be easily got over.

Prof. Kennedy referred to a table of costs of copper and noticed that the price of the metal had risen to £78 per ton. If the price still rose it might become desirable to use aluminium for conductors.

THE COMPARATIVE ADVANTAGES OF ELECTRICITY, STEAM AND COMPRESSED AIR FOR MINING PURPOSES.

By Henry Slade Childe, M.Inst.C.E.

The comparative advantages of electricity, steam and compressed air for mining purposes opens out a large field for discussion; but for the purpose of this meeting it may be possible to lay down a few general principles without being accused of only skimming over such an interesting subject.

Surface.—Here in almost every case steam is the most adaptable and economical, and, therefore, most commonly used; and it can only be in exceptional cases where it is proposed to carry on some new branch of colliery work that electricity can successfully com-

pete with steam, and then only when it is not possible to erect boilers, chimney-stacks, &c., or carry the steam a considerable distance in large pipes, or not thought advisable to have the hauling engine in the mine. In this event it has been found that by putting the dynamo or generating plant near the boilers, and carrying the cable in the ordinary course, electricity can be used on the surface, or conducted down the shaft by putting the cables in 1½-inch iron pipes.

In the Shaft.—There are some cases where steam pumps are fixed in the shafts, below the water-bearing strata, where the water is caught and lifted to the surface. It is seldom possible to use steam for this purpose, except where the pumps happen to be in an upcast shaft, which is very infrequent; but where this is the case of course to some extent the heated steam pipes and the exhaust steam assist the ventilation; but, on the other hand, the pump suffers by reason of being fixed in an atmosphere that contains many gases acting injuriously on the different metals.

Compressed Air has been tried for this class of work; but although more advantageous than steam, it does not quite meet the difficulty.

Electricity, however, has been found to answer admirably; and the writer knows of collieries where the pumps are actuated by this power, and are carrying out the work economically and with great satisfaction.

Underground.—There are three main purposes for which the powers named will be required underground, viz, "hauling," "pumping" and "coal-cutting."

Steam for Hauling.—With regard to the use of steam for this purpose, the steam from the surface-boilers is usually conveyed down the pit in properly lagged pipes, and then conducting it to the bottom of the downcast pit, where the engines are placed. The difficulty of getting rid of the exhaust steam is met by returning the steam to the upcast, or sending it through into some old return air-ways. Neither of these methods, however, can be considered as satisfactory, and there is always some escape of steam from engines and pipes which is picked up by the air-current and carried in-bye; and for a considerable distance from the pit bottom there is a moisture which affects the roofs and sides of the mine, and causes them to fall and slip.

Steam for Pumping.—The writer knows cases where steam has been taken in 6-inch pipes to the distance of a mile from the pit bottom; but in his opinion this was most unsatisfactory, although it did unwater an area of coal that was below level. The pipes were taken along the return air-way, and, although protected, a great amount of steam was lost.

The question of getting rid of the exhaust in the steam pump is not so difficult, because it can either be turned into a condenser or into the rising main; but even this necessitates a few minutes' escape of steam every time the pump is started.

Coal-Cutting.—Of course steam is entirely out of the question for this work.

Compressed Air for Hauling.—This has been found to be most useful when the hauling engine is placed at the shaft bottom, or in-bye, and the writer is connected with collieries where half a dozen hauling engines are used bringing coal up inclines and along levels to the main road, whence the main hauling engine, worked by compressed air, brings 30 or 40 tubs to the drawing pit.

The difficulty, however, of keeping tight joints for compressed air is very considerable, and the loss between the air compressors and the engine amounts, in some cases, to as much as 70 per cent., and that within the distance of, say, three-quarters of a mile.

Pumping.—Whatever may be said of the advantages of compressed air for hauling apply equally so for pumping; and there are, of course, a great many instances of pumps in mines worked by compressed air.

Coal Cutting.—Most of the coal-cutters in use at the present day are actuated by compressed air; and if the main pipes are sufficiently large, and joints can be kept tight, it is a question whether there is any power to beat it; it is easily controlled, and possesses one other feature that a mining engineer looks upon as of the utmost value, viz, safety, in addition to keeping the working places somewhat fresher and sweeter, and in a manner assisting ventilation; but, on the question of economy, it is not, in the writer's opinion, so cheap as electricity.

The presence of a line of steam or air pipes in any air way is inconvenient, irrespective of heat and escape of steam, and it must be borne in mind that the roadway of a mine is continually on the move, and that pipes are always leaking more or less, and take a good deal of time to make a perfectly tight line.

Electricity.—As stated under the first heading, this is not used much on the surface.

Pumps in Shafts.—See beginning.

Hauling.—For hauling at the pit bottom electricity is used at several collieries, and is coming more into operation, the ease with which a cable can be taken down and fixed in the shafts and roads of the mine being of great value.

Hauling and Pumping in-bye.—For small hauling engines and pumping engines, electricity is most convenient; the motor can be easily fixed and removed, and the very great value of electricity in the main lies in the fact that the cables can be taken from place to place with such little trouble. It is difficult to say exactly the difference in time occupied between laying, say, a mile line of 6-inch pipes for compressed air, and a cable an inch in diameter, but it will be about as 6 is to 1 in favour of the cable; and where hauling and pumping machinery are in main intakes there is no doubt in the writer's view electricity is by far the best agent.

The writer is acquainted with a case where, in order to work an underground pump in a lower seam, a bore-hole was put down from the upper seam quite a mile away from the pit bottom, and the cable put through. This is one instance of the adaptability of electricity.

Coal Cutting.—Here electricity has been much used; but it is a moot point whether its many advantages overcome the risk.

At the present moment no explosion can be traced to electricity, because the users of it have been comparatively slight; but it stands to reason that if an explosive admixture comes in contact with an electric spark an explosion must result; it cannot, therefore, be used with complete safety, although, if the continuous current is converted into three-phase alternating current, no sparking will occur, as there are no rubbing contacts; but even this is not quite satisfactory.

Summary.—For general surface purposes steam is undoubtedly first; for working in shafts and for all underground work (excepting on the one ground of safety) electricity has the advantage over compressed air.

CRANES, AND THE POWER TO BE USED WITH THEM.

By WALTER PITT, M.Inst.C.E.

FOR the purposes of this short note, cranes may be considered as roughly divided into two classes—first, self-contained cranes carrying their own motive power, and, secondly, cranes which are actuated by power conveyed to them from a separate generator. The first class practically consists of hand and steam cranes, and the second includes all the various forms of power transmission cranes, such as shaft-driven, electric, and hydraulic. Of hand cranes, it is only necessary to remark here that, wide as is the field of usefulness for moderate sizes, the practical limit is soon reached. It may be assumed that eight men is about the maximum number that can be put to the handles of a single crane; this corresponds to a total effective work at the hook of about 15 foot-tons per minute, or, put another way, it takes 15 minutes to lift 15 tons 15 feet high. Speaking generally, for loads over 10 to 12 tons, a hand crane is out of place, unless the circumstances are very exceptional.

The steam crane is undoubtedly the best type to use where only a single crane is required, or where several portable cranes have to be dealt with whose relative positions may be altered within wide limits, or which may at some future date be transferred to another site; in all these cases the steam crane has advantages not possessed by any other type. It is simple to work, as economical as most of its rivals, ready at short notice, and requires little permanent work for its installation, except in the larger sizes of fixed cranes. When, however, it is a case of an overhead traveller, or several fixed cranes, or a number of portable cranes with a limited range of travel, then the consideration of other motive power than steam at once begins.

An overhead traveller is in many cases placed under cover, where a steam boiler placed close under a roof possesses obvious disadvantages, and in very many cases an available supply of power already exists. The overhead traveller has therefore always been well adapted for driving by transmitter power, and the evolution of the power traveller has been roughly as follows:—1st, shaft-driven traveller; 2nd, rope-driven traveller; 3rd, electro-driven traveller.

Shaft-driven travellers work very well where the motive power is not too far away, but they have disadvantages. The loss in friction is probably the greatest of all systems; the speed at which the transmitting organ (the shaft) can be driven is necessarily very limited, and the tumbler bearings are always inclined to be troublesome.

For conveying power by direct mechanical means, it may be considered an axiom that a quick light drive is always to be preferred to a slow heavy one, and therefore it was a decided step in advance when the quick-running rope-crane came in, and by a process of the survival of the fittest settled down into the well-known type in which the driver sits in a cage below the girders and actuates the machine by shifting open and crossed belts, the speed reduction being made at the crab by worm and wheel. The introduction of the electric transmission of power marked a noteworthy departure in crane design, and solved in a very satisfactory manner all the difficulties previously experienced in taking the power from the motor to the crane.

Electric leads are easy to erect, noiseless, motionless, cheap, and by their means power can be conveyed along routes that would be quite impracticable by any other means, and with very considerable economy. The author puts the latter point last, because although users much appreciate economy, they appreciate convenience a great deal more. Speed and convenience of working take precedent even of coal consumption.

The first electric cranes and travellers were worked by a single motor often kept running continuously, and the various motions were obtained by shifting belts or other forms of friction clutches. Latterly the practice has been to use a separate motor for each motion. Having got so far, a lesson was taken from tramway practice, and series-wound motors were used instead of the self-governing shunt-wound motor previously necessary.

The series-wound motor, with its big starting torque and its capability of responding to the drivers' views as to speed, has much analogy to the engines of a steam crane regulated by the drivers' hand on the starting valve, and the writer thinks that it is precisely this possibility of using series-wound motors that is the great advantage of the single-motor machines. Jib cranes are usually now constructed as two-motor machines, one for lifting and one for slueing. The subsidiary motions of jib derricking and travelling are less often used, and can be well worked from the slueing motor by a change of gear.

The reduction of speed from motor to first motion shaft has been effected in every possible manner. Practically two methods survive, worms and cut gear. The much-despised worm is noiseless, and very convenient to apply in many cases, and, if properly designed,

even a worm will turn, and that with a very respectable efficiency. The author would remark in this connection that the ordinary formulas for worms will, if used with proper coefficients of friction, give results well borne out by practice. The next important organ in an electric crane is the controlling gear. Here the tendency has been lately to adopt liquid resistances, and still more recently to use controllers which are practically tramcar controllers. It is a striking feature of electric crane design that whereas at first the old power traveller was the model, the tendency is now to go to tramway practice, and there are, in fact, many points of analogy between crane and tramway work, especially in all that concerns the starting and accelerating conditions. In Germany considerable attention has been paid to the problem of recovering the energy lost in lowering the load by generating current in the motor. Many of these arrangements are very interesting, but the writer doubts whether here again efficiency of doing the work required does not take precedence of current consumption, and for quick lowering nothing beats a free barrel controlled by a foot-brake.

The hydraulic crane is too well known to require long notice here, it will probably be always with us, but the electric crane will be a very serious rival. The electric crane itself is more expensive, but the generating and transmitting plant are less costly. Electric cranes are not affected by frost, and they also have the good point that the maintenance repairs are generally within the competency of the man who looks after the crane. Of various intermediate types of crane, the writer would mention a series of overhead shaft-driven travellers driven by hydraulic engines from a pressure main, and the result has been sufficiently satisfactory to warrant a repetition of the design.

Another example of a different type of motive power is furnished by a crane designed by the writer, where, a good natural supply of water under moderate pressure being available, a Pelton wheel was keyed directly on to the pinion shaft of the lifting gear, and a cheap and efficient hydraulic crane constructed. The author also remembers having seen at Bilbao a blockyard Goliath, where an electric transmission actuated a direct-acting hydraulic lifting cylinder, and there are other variations and combinations of motive power that may sometimes be authorised by the local condition. Speaking broadly, the author would emphasise the following points:—

1. For single cranes, or cranes with a great range of portability, use steam.

2. In all cases where the circumstances warrant a central power station, or where power has to be conveyed any distance, use electricity.

3. For overhead travellers, use electricity.

Discussion on Mr. Cuningham's Paper, Thursday, June 8th.*

Mr. Clibehugh said that he should be glad to know definitely why high speed engines had been discarded in favour of low speed engines.

Mr. Henry Mayor said that in the case of Glasgow the power and lighting stations were separate, and it was open to doubt whether this would not result in an increased cost of coal to the Corporation. He thought that the overhead system in Glasgow would probably be replaced before long by the underground system. It would be worth while to construct a conduit, and in the busiest thoroughfares the underground railway already came within 2 feet of the street level.

Mr. Hammond thought that the results obtained in Leeds might be interesting, as they bore out the author's statement that a reduction of 5d. per car mile could be made by using electricity. In Leeds the horse cars cost 10·17d. per car mile, steam cars 10·33d., electric cars 4·83d. The generating expenses in Leeds were 0·6d. per Board of Trade unit which was considerably higher than the author's figure of 0·25d. The cost of producing electricity for lighting was 0·78d., and the output for traction and lighting was practically the same. He had found that slow speed engines used less coal than high speed, and doubtless the traction load factor in Montreal was higher than for lighting here.

Mr. Crompton thought the figures given by the author extremely good: he himself had put down slow speed engines and high speed engines side by side, and thought the cost for oil and labour was higher in the latter case, although it used somewhat less steam. Figures for traction work should not be compared with those for lighting, but he would compare them with some figures obtained from chemical works. The fuel had cost 0·14d., and the remainder 0·13d., making a total of 0·27d., with high speed engines, this he considered very good, but there were, of course, no distribution charges.

Prof. E. Hopkinson noticed that the author gave the price per Board of Trade units as 0·25d. and the cost per car mile at 0·5d. He thought one unit should be sufficient per car mile.

Mr. Tremlett Carter asked if the cars were of the double bogie type.

The Author replied that they were of the single bogie form carrying 26 passengers inside. The author also stated that Montreal was very hilly, some of the gradients being 1 in 10, and one as steep as 1 in 8; the speed of the cars was 10 miles per hour in the town and 12 miles in the country, the average throughout the year was 2 Board of Trade units per car mile.

Major Cardew thought 70 revolutions very low for the engines, the units per car mile would, of course, include all leakage losses.

Mr. Monkhouse considered a saving in the power station could be effected by using a holiday plant. He had visited the United States, and the cost of power was nothing in comparison with the cost of maintenance. Inspection did not seem sufficiently good, and leakage was considerable. He found on one track, 21 miles long, that the third rail was simply laid on paraffined blocks of wood; the leakage was 14 amperes, and still higher in wet weather. In New York the leakage is 0·5 ampere per half-mile section of double track.

Mr. Grimshaw thought the author got much greater saving by using an economiser than would have been expected.

Mr. Patchell remarked that the author had read a fuller paper on the same subject in 1896, and the temperature of the gases leaving the boiler were much lower than usual.

Prof. Kennedy stated that he had examined many accounts of American electric railways, and found that the expenses for drivers and conductors came to 42 per cent. of the whole outlay. Power cost 18 per cent.; maintenance of line, 12 per cent.; maintenance of plant, 12 per cent., and general charges 16 per cent. Costs for power had been reduced in certain cases to 10 per cent.; he could see no difference in economy between slow and high speed engines.

Mr. Cuningham, in his reply, said that in 1892 high speed engines at 250 revolutions were put down in Toronto and used for 1½ years, but then they were taken out and slow speed engines substituted, in order to save fuel and expenses in repairs. The high speed engines were of the Armington-Sims type. In Montreal they used 2 Board of Trade units per car mile, in Toronto 1·5, in Brooklyn 0·8, and in Dublin 0·9, according to Mr. Parshall. The temperature of the feed water was 270° F. at full load; the figure of 0·25d. was not obtained from a test run but from months of ordinary working.

* See page 1,000 *ante*.

THE TELEPHONE SERVICE.

In the House of Commons on Tuesday night Mr. Hanbury moved the second reading of the Telegraphs (Telephonic Communication, &c.) Bill, which is as follows:—

A Bill to make further provision for the improvement of Telephonic Communication, and otherwise with respect to Telegraphs.

Be it enacted by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

1. The Treasury may issue out of the Consolidated Fund or the growing produce thereof such sums not exceeding in the whole the sum of *two million pounds*, as may be required by the Postmaster-General for the purpose of the Telegraph Acts, 1863 to 1897, according to estimates approved by the Treasury, and sub-sections two and three of section one of the Telegraph Act, 1892 (which relate to the mode in which money may be raised) shall apply with respect to the sum so authorised to be issued.

2. (1). Where the Council of a county borough are licensed by the Postmaster-General to provide a system of public telephonic communication, they may defray the expenses of exercising the powers conferred by the license out of the borough fund or borough rate, and may borrow money for the purpose in accordance with the Public Health Acts, but any money so borrowed shall be borrowed on the security of the borough fund or borough rate, and the Council may, subject to the provisions of the Telegraph Acts, 1863 to 1897, and of the license, exercise their powers under the license throughout the area for which it is granted, although part of that area may be outside the borough.

(2). In the application of this Act to Scotland, a Royal or Parliamentary burgh having a population of over 50,000 according to the last census for the time being shall be substituted for a county borough, and the Town Council or Commissioners thereof for the Council of a county borough, and the police or borough general assessment or rate of the like nature for the borough fund or borough rate; and the Council or Commissioners may, with the consent of the Secretary for Scotland, borrow for the purposes of this section on the security of that assessment or rate, but subject to the conditions for the repayment of loans prescribed by the Public Health (Scotland) Act, 1897.

(3). In the application of this section to Ireland, the Public Health (Ireland) Acts, 1878 to 1896, shall be substituted for the Public Health Acts.

3. This Act may be cited as the Telegraph Act, 1899, and may be cited with the Telegraph Acts, 1863 to 1897.

We are indebted to the *Times* for the following report of Mr. Hanbury's speech in which the Government policy is explained in detail:—

Mr. Hanbury said that the time which had elapsed since he introduced the measure had produced one result. Complete unanimity had been shown on one point, namely, that the present system could not possibly go on. There had not been a single resolution from a local authority, no memorial from a trading association, not an argument in the newspapers, which had supported the existing system. The company had itself introduced Bills, which was the clearest evidence that without fresh powers the present system could not go on; and he was sure that the House was not prepared to grant fresh powers to a company which had already very large powers, and which was absolutely uncontrolled. Authorities at Liverpool had requested the Parliamentary representatives to oppose any extension of the powers of the National Telephone Company, and a resolution had been unanimously adopted by the Association of Municipal Corporations to the same effect. And surely there was very good reason for a step of that kind being taken, because the figures with regard to the state of the telephonic communication in this country were positively alarming. In Switzerland there was one telephone in use for every 100 population; Norway, one in 144; Sweden, one in 147; the United States, one in 132. In all those cases there was practically no State system, but one, worked by local bodies or general competition. Taking the principal countries where there was State control and no competition, in Germany there was only one telephone for every 449 inhabitants; France, one in 1,432; Austria, one in 1,640. England, even as compared with Germany, was far behind, for she had only one telephone for every 636 of the population. Passing from the countries to the principal towns, he found that in Stockholm, where there were actually three systems in competition with one another—which was a considerable argument against those who said competition was impossible in this matter—the number of telephone users was one in every 14 of the population; Geneva, one in 23; Berne, one in 27; San Francisco, one in 27; Hamburg, one in 56; Berlin, one in 82; Vienna, one in 132; London, one in 433.

Sir J. Fergusson (Manchester, N.E.): Where did the right hon. gentleman get those figures?

Mr. Hanbury: I got my figures from the chief engineer of the Post Office made up to date only yesterday. It was not necessary, however, to go beyond our own country for examples. The National Telephone Company's service has been established in Jersey for a considerable number of years, and there the telephone users were as one in 650 of the population. Now, in Guernsey, which was one of the places where the Post Office had granted licences to the local authority, the proportion was one in 84, although the system had only been started about two years ago, and the number of subscribers was growing rapidly every day. He thought, therefore, their first essay in the direction of municipal telephones had not been unsatisfactory. He frankly recognised that the National Telephone Company had done good work, and wherever it had got wayleaves and could give an efficient service, serving all alike on equal terms, he should be sorry to see that system discontinued. What we wanted in this country was a general system that would extend itself over the whole country, but the National Company picked out the most densely populated parts of the country. Being a private company it naturally consulted its own interests. He would do the National Telephone Company the justice to say that wherever they got the opportunity they gave an efficient service—that was to say, where they had underground wayleaves and a double circuit system. But there were a large number of municipalities which would not give these underground wayleaves, and in those towns the company could not give an efficient service. Parliament had always refused to give wayleaves, and no Government had ever supported the granting of them. But it did not follow because the company could not get wayleaves that the country was to go without an efficient telephonic service, which was so important to the trade and commerce of the country. Five-sixths of the present wayleaves could be terminated by those who granted them within six or 12 months, and it could not be permitted that a national service should exist on such a precarious footing as that. These being the requirements, a good many persons had jumped to the conclusion, on the analogue of the Post Office and telegraph service, that State telephones were the only solution of the difficulty. It was not surprising that the ingenious directors of the company should back those people up in that view. The indirect influence that the company was bringing to bear—where it was hard to say where public policy begins and private interest ends, where all kinds of preferences and trusteeships could be put into various hands—constituted one of the greatest arguments against an enormous monopoly like this. He fully admitted that the control of the whole telephone service must be in the hands of the Postmaster-General. It was necessary for uniformity, and under this Bill, for the first time, they should be able to get that uniformity, and they should be able to resist the imposition of terminals, which they could not do in the case of the National Company. He saw no reason, however, why the State should actually undertake work which could be just as well done by the local people on the spot. Something like 98 per cent. of the whole messages in the exchange never left the locality, and never came on the trunk wires. There being no practical and technical advantages in State management, why should they incur an enormous and unnecessary increase in the staff of the Post Office, and the corresponding increase in wages? The Postmaster-General was already the greatest employer of labour in the world, and the staff was growing year by year. Again, the wages of the company's servants were, as compared with those paid by the Post Office, exceedingly small. In the case of the trunk wires which had been taken over the wages had to be raised 40 per cent., and they would have to do the same by the others, in addition to providing for pensions, in order to place them on the same footing as the telegraphists, who, as they knew, were not at all satisfied with their conditions of service. Nationalisation of the telephones meant immediate purchase at an accommodation price; it meant buying up the National Telephone Company as it was at the present moment, a monopoly—a monopoly which he thought ought never to have been allowed to grow up; and it meant that they should have to buy as a going concern a monopoly which would fall into their laps in 1911. While he was most anxious that they should treat the company with absolute fairness, he thought that to ask them to buy up that monopoly as a going concern was to ask too much of them. If they decided to buy up the company, he candidly admitted that the purchase would include much good work, as at Liverpool, where the service was as nearly perfect as it could be made, and where any change was unnecessary; but in other places the system was not so perfect, and he objected even more to buying up the latter than the former. Twenty-five per cent. of the company's system consisted of single wires, and in London and a number of provincial towns practically nothing but overhead wires prevailed, which would be absolutely useless to the State. They were made of very poor material, many were disused, and a large number were private wires outside the monopoly altogether. Another objection to nationalisation was that, owing to the improvements which have been effected in Liverpool and other towns, the State would be called upon to first buy up the wires with those improvements, and then to replace them. If they were to spend money on the telephone system, he should like, in the first place, to get value for it; to spend it, not in replacing and supplementing the company's system, but in bringing ourselves to the same level as other countries. The president of Council of Associated Stockbrokers, who had taken such a very prominent part in that question—he did not know why—said that "Either the Government should assume sole control, or give those at present working the telephones full power of developing the same, subject, of course, to control." He had already explained that that could not be done in the places where the company had no wires already, and those were the very places where the State would have to provide them. To suggest that the Post Office should go through the form of calling the company its agent, and then use its own powers over the heads of the municipalities in order to give them wayleaves, was absurd. Having shown the practical impossibility of a State system, and that the company could, under no circumstances, supply places where there were no proper wayleaves, they were thrown back upon only two other sources of supply. One was the local authorities, which he proposed should include sanitary districts, thus carrying the telephone system to almost every part of the country. Corporations which were unwilling to grant wayleaves to a rich and powerful company, might be willing to grant them to small local companies over which they could have more control. With such small companies fair conditions could be imposed, and preferences could be guarded against, or the refusal to serve all alike upon equal terms. By that means he believed as good a service could be given in all respects as the State could possibly give, and any friction between the State and the local authorities would be avoided. That local service would supplement the National Telephone Company's system in very large areas, and would have the effect, he believed, of bracing up the company and making it give a better service, even where a municipality itself would not compete or allow another company to do so. All that they wanted was to get an efficient service and to see, further, that it was fair to the company, who had done a great and useful work. It was admitted from the first that there was no unfairness, and he thought that would be admitted by his right hon. friend. It had never been a question that it was perfectly fair to start new companies in opposition. Then came the municipalities, to which the company raised great objection. The Government in this matter had tried to balance advantages and disadvantages, and they had offered, in a Treasury Minute, the recommendations, arrived at, he believed, unanimously, of the Select Committee. They offered to purchase the plant, such as was suitable and fit, under certain conditions in 1911, and, considering that in 1911 they would be under no obligation to buy one pennyworth of the company's plant, that was a very large offer. In addition, under certain circumstances, they were going to impose somewhat stringent conditions upon municipalities, and there were also other proposals which, he thought, formed a large and fair offer. As he had said, what they wanted mainly was an efficient service. It did not matter whether that service was given by the company or the municipalities or other companies. Referring next to a resolution passed by stockbrokers declaring that the Government were attempting improperly to depreciate, so as to ultimately purchase the property at a low price, all that he had to say was that, as the Government had no intention of purchasing at all, the resolution was somewhat wide of the mark. Now what were the objections and who were the objectors to this proposal? In the first place, the main objection came from the large traders of the country, and it was remarkable with what unanimity and sameness of language all the resolutions were passed. In addition to the stockbrokers and lawyers they had the chambers of commerce, which represented the larger traders of the country; but at the utmost only 22 chambers out of 96 had offered any opposition to this Bill. The large traders objected because they were getting uncommonly good value for their money. For a subscription of £15 in London and £10 in the provinces, they monopolised the whole of the exchange and the trunk wires; and for this sum they had the unlimited right of sending messages. He asked them to imagine the telegraph system of the country worked on that principle. Men in that favourable position did not want to be disturbed. Thus they had one man getting £300 worth of messages for £15 to £20 a year. What was wanted was to make the service a popular one, as open to small as to large traders. Small traders had memorialised the Treasury time after time that this concession might be made. It was complained that the trunk wires were crowded; and he thought that they must, in order to remove the last objection, increase the number of trunk lines. As to the large towns, after all, the objection came from Liverpool and Nottingham; and they were in a minority. Well, they were the only two corporations which had memorialised the Government, and it so happened that they were the two who were exceptionally well off. They had made a good bargain with the National Telephone Company, and had got a very good service. But why should they stand in the way of other municipalities which had not got such an efficient service, and why should these big corporations, which were able to hold their own against a company like the National Telephone Company, stand in the way of the smaller municipalities which were not so well able to fight their battle with the National Company? The only objection taken by the Town Clerk of Nottingham was that no other system but a national system would supply the country districts. He did not believe it. He thought companies would supply those districts just as well as the State. (An hon. member: And better.) The Town Clerk of Liverpool admitted that he had no objection whatever to municipal enterprise in telephones where there was no service at the present moment and no competition with the National Telephone Company. Well, what an enormous area that was. Then, again, the town clerk opposed it on the ground of the limited use of telephones, and that it did not extend to the bulk of the population. It did not at the present moment, and as long as the present system went on it never would. But if the toll system were introduced there was no reason whatever why in a great number of their towns there should not be just as large a proportion of telephone users as in Stockholm, or Geneva, or Berlin. The information sent to him only a couple of days ago as to Guernsey furnished a remarkable illustration of what municipal enterprise would do. The States of Guernsey only started the telephone two years ago, and they had already got one telephone to every 84 of the population and a tariff which met every class of subscriber. The result was that they were paying interest on their capital, a Government royalty of 10 per cent., and were also building up a sinking fund. Local authorities were, after all, the best judges of their own interests. They need not start a

service if they did not want it, or if they thought it was not to the interest of their ratepayers, especially now that they were giving them three alternatives. In Stockholm, where there were more telephone users to population than in any place in the world, they had three systems working side by side in opposition to one another. (An hon. member: At a great loss.) No, not at a loss. There was the State system and two companies. They had in this country got their own Post Office exchanges, but he was bound to say that, owing to Treasury regulations, they were not worked as they ought to be. That he perfectly admitted, but even so, they had been paying a large interest on their capital. An intelligent Treasury had now abolished those regulations. It was true that the National Company was to a certain extent at a disadvantage in that it did not get underground wayleaves. But in Manchester it had those wayleaves, and yet there, though the National Company was giving an efficient service, a new company had applied for a licence, with the support, he believed, of the corporation. That did not look as if competition within the same area was such a dangerous thing for the municipality. Then there was another alternative. The local authority might buy up the National Company in any area, or—and he thought this was much the more likely course—there might be a connection between the service of the company and that of the municipality. The Government were offering them every inducement to do that, and the very able manager of the National Company had admitted that he did not think there would be any practical difficulty in carrying out such an arrangement. He believed, too, that the company would find it to its own interest to adopt such a course. It had been objected that corporations would not give a popular service. Corporations would have to please their constituents, and if their constituents wanted this service and did not get it they would turn out the corporation who refused it and put in one who would give it. What were the inducements to a popular service? Well, in America, within the last three years, since the service had been made a toll one, it had grown by leaps and bounds, and only yesterday he had read a statement to the effect that Germany had also introduced the toll system, and was popularising its service, not only in Berlin, but throughout the country. It had been urged that they did not give corporations sufficient time to recoup their expenditure. He thought that even 12 years was a considerable time for that purpose, but the House must recollect that under the conditions which they were offering they would only have to redeem 50 per cent. of their capital by 1911. They did not regard it as by any means a certainty that 1911 would see the end of the licences of their new licensees. If nationalisation were as unpopular with the Government of that day as it was with the present Government, municipalities would retain the service long after 1911. He hoped he had made the case perfectly clear. He hoped there was no impression that they were anxious in any way to take an unfair advantage of the National Company. On the contrary, he thought he had shown the House that, if their proposals were accepted, that company would be in a better position than they had ever been in before—they would, at least, be in a much more certain position. Not only so, but they would get a popular service and a service not dependent on a precarious tenure as it was now. He hoped the House, looking at the emergency of the case, and to the fact that the United Kingdom lagged far behind other countries in the matter of telephonic communication, which was so essential to their trade and commerce, would agree to the second reading of the Bill and to passing it through its other stages without any unnecessary delay.

In the course of the debate which followed, Sir J. JOICEY said he recognised that the service supplied by the National Telephone Company was inadequate, but did not approve the methods adopted by the Government for the purpose of bringing about an improved state of things. Mr. GRIFFITH-BOSCAWEN, on the other hand, supported the Bill, which, he said, carried out the recommendations of the Telephone Committee.

Sir J. LUBBOCK doubted whether it could be maintained with justice that the service of the Telephone Company was inefficient. Where it was inadequate the fault was not theirs, but that of the municipalities which refused to grant wayleaves. Having said that the Bill was open to the damaging criticism that it proposed a great extension of municipal trading, he turned to the proposal that the Government should itself institute and work a telephone system in London, and mentioned three objections to it—namely, the risk of loss to the taxpayers, the inadvisability of increasing the numbers of Government employés, and the effect of the scheme in checking private enterprise and impeding the progress of applied science. He suggested that the Bill should be sent to a Select Committee for consideration.

Sir J. WOODHOUSE, who supported the Bill because it was likely to lead to an improved and cheapened service, referred to the tremendous efforts which the Telephone Company were making to prevent the measure from becoming law; Mr. C. MCARTHUR, who claimed to give expression to the unanimous opinion of Liverpool, opposed the measure; Mr. FAITHFULL BEGG, who spoke amid considerable interruption, advocated the nationalisation of the telephone system; and Mr. LAWRENCE, who criticised the Bill adversely, continued the discussion until midnight, when the debate stood adjourned.

The Bill passed its second reading on Wednesday without a division, Mr. Balfour asking the House to refer it to a Grand Committee. After several members had spoken regretting the proposal, Mr. Balfour moved that it be referred to the Standing Committee on Trade, and the debate was immediately adjourned.

Comstick.—This is the name of a material sold in sticks specially prepared for lubricating dynamo and motor commutators. A sample stick is before us. It is claimed to keep the commutator in a good condition, prevent cutting, and promote a high gloss. Messrs. Cuttriss, Wallis & Co., Limited, of Leeds, are the manufacturers.

THE MUNICIPAL ELECTRICAL ASSOCIATION.

FROM a social point of view the Bristol meeting of the Municipal Electrical Association was an undoubted success, but whether it came up to the anticipations of those who expected to derive some substantial addition to the knowledge already in their possession, is open to question. Several of the papers read and discussed were of that class on which there was practically but one opinion, therefore much valuable time was wasted in constant reiteration of the same thing. The paucity of the papers, too, contrasted rather disadvantageously with those of former years, and their calibre was distinctly of a lower order. Possibly some of the more prominent members of the Association found themselves unable to spare the necessary time for working up interesting and novel subjects to bring before their colleagues—in one instance, at least, we know this to be the case—and so the Committtee were perhaps compelled to fall back upon several of last year's topics, together with hastily-compiled papers on others as stop-gaps. Anyhow, there was a feeling of weariness and lack of real interest during the hours set apart for the work of the session, which was strangely at variance with one's recollections of, say, the Manchester Conference. Naturally the absence, after the opening day, of Mr. Faraday Proctor and Mr. Councillor Pearson, did not tend to make the meetings any the more exhilarating, the latter gentleman's lucid style and business-like and thorough grasp of whatever subject he took in hand, combined with his quiet humour, being sadly missed. The proceedings may, therefore, be generally characterised as having been somewhat dull and listless except for occasional flashes of merriment when Mr. Ferranti, Mr. Chamen, Bailie Maclay, or Mr. Wordingham, took part in the debates.

On the other hand the dinner, the success of which might at first sight have seemed imperilled by the non-appearance of Sir W. H. Preece, Mr. Alexander Siemens, and others who were announced to speak, was a bright and cheerful function, marred only by the enforced absence of the president and the chairman of the Electricity Committee, both of whom have done so much for the development of electric lighting in Bristol. How the evening was spent will be found in a special account given in our other columns.

The recreative part of the Conference probably has never before been equalled in the short life of the Association, nor has such lavish hospitality been proffered to the members at every turn. The Corporations of Bath and Cheltenham, and the Bristol Tramways Company, all vied with one another to do honour to the occasion, and make the visitors' annual re-union a brilliant and enjoyable one, and from the hour of the charming luncheon, given by Mr. Pearson at the Royal Hotel after the opening meeting, till the afternoon of the Lord Mayor's garden party, the greater part of the time was wholly given over to pleasure.

To the visitors probably the most attractive feature of the electrical system at Cheltenham was the arc lighting. It should be mentioned that the thoroughfares in that town lend themselves admirably to showing off the peculiar advantages of arc lamps, and to the special attributes, such as magnificent rows of trees alongside the roads, is due in a great measure the success of a remarkable example of outdoor illumination. There are over 200 arc lamps in use, to each of which is assigned a transformer placed in the base of the lamp-post; they are arranged on alternate circuits, and at midnight half of them are extinguished. The charge per annum per lamp varies from £19 10s. down to £15, the price varying according to the number of lighting hours. The purity and steadiness of the lighting excited much favourable comment.

A sumptuous collation had been provided at one of the municipal parks by the Mayor of Cheltenham, Mr. Alderman Norman, who has been the chairman of the electric lighting since the inauguration of the municipal system. The party was afterwards driven round the town to inspect the lighting, paying, on the way, a short visit to an open-air concert, another of the admirable institutions controlled by the Corporation.

The Bristol Electric Tramways were also the object of an afternoon's diversion, and a gratifying surprise was that of

an unexpected and *recherché* luncheon, prepared for the visitors at the terminus of the system at Staple Hill, some 4½ miles from the centre of the town. Mr. George White, the managing director of the Bristol Tramways and Carriage Company, was unfortunately detained in London, but Mr. Clifton Robinson, engineer, and Mr. Challenger, traffic manager, welcomed everybody with open arms, and the company's lavish and generous hospitality will not readily be obliterated from the memories of those present. To those local authorities who are hesitating as to whether or not they should adopt electric trams, we would suggest that a visit to Bristol would be an object lesson not to be despised, and it might also save an expensive trip to the Continent, of which some electricity committees are so fond.

Included in the programme of the Conference was a visit to the Somerset city, and those who made the trip spent a pleasant hour or two. Mr. Gustave Metzger, the electrical engineer of Bath, met the visitors at the station, which was thoroughly inspected. Before leaving Dorchester Street, Alderman A. Taylor, the genial chairman of the Electric Lighting Committee, invited the visitors into the offices, where refreshments were served.

Mr. Wordingham, in his post-prandial oration, struck a note with which we are in perfect accord. There is a danger that the festive side of the Conference will usurp the real practical objects of the Association, and this has been foreseen by the Manchester municipal engineer. Nothing that we can say would add force to his warning; the Committee must look to it that the annual meetings do not some day resolve themselves into the scientific picnics of the B.A. on a miniature scale.

The members of the Municipal Electrical Association are our guiding stars, and mainly through their agency shall we bring electricity into the houses of rich and poor alike.

The proof of the vitality of electric supply lies not so much in the establishment of new works as in the extensions of old ones, and we are glad to recognise that municipalities as well as companies in coping with the great and growing demand are inclined to adopt a bold and vigorous policy. There is, nowadays, no need to adopt the cautious tactics that were pursued by the pioneers of public supply; it has been abundantly proved that electrical undertakings are commercially sound, and most questions affecting the economical generation and distribution of electricity have been already threshed out. Therefore, in extending works it is little use making two bites at a cherry.

Without discussing new spheres of municipal activity, we should rejoice to see Corporations doing that work which lies to hand, in a complete and efficient manner, and no one can deny that much remains to be done before we can say that electricity is in universal use.

To some of us who have spent the greater part of our life's work in the cause of electrical science, the progress does not appear to have been rapid, but when one goes into statistics one finds that some advance has been made, for whereas in 1890 there were 17 stations having some 200,000 lamps connected, and representing a capital of £650,000, there are now, roughly, 150, with 6,000,000 lamps and £13,000,000 capital.

At the recent Conference of the Civil Engineers, Sir W. H. Preece, in the course of his presidential address, said: "The proceedings are thrown open to the Press, and we hope that the enterprise of those admirable technical papers, that are such a credit to our industries and such a benefit to our profession, will, by the completeness of their reports and the rapidity of their issue, render full publication on our part unnecessary."

The doings of the M.E.A. command much consideration from the technical Press, and we trust that our comments will be received in the same frank spirit in which they are written, for we have the welfare of the Association at heart, and look forward to its vigorous growth and expansion from year to year. The sympathies of the whole meeting were with Mr. Proctor and Mr. Pearson, and the expressions of regret at the hardship which compelled these gentlemen to attend a Parliamentary inquiry just at the very moment their presence in Bristol was so necessary for the purpose of making the meeting a record one, were as unanimous as they were sincere.

To Mr. Mountain, who has done so much for the Association, we extend our hearty congratulations on his election as next year's President.

CORRESPONDENCE.

Capacity Measurement of Long Submarine Cables.

There were two errors in the copy of my letter (ELECTRICAL REVIEW, June 2nd), *re* "Capacity." One was "corrections" for "observations" in the second paragraph, the other—the numbers of the figures were transposed.

W. Murphy.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

WEEK ENDING JUNE 21ST, 1898.

Adelaide	..	Value	£261
Alexandria.	Teleg. mat.	..	52
Amsterdam	..	..	170
Archangel	..	..	378
Auckland	..	..	17
Bombay	..	..	145
Boulogne	..	..	57
Buenos Ayres	..	..	40
,,	Teleg. mat.	..	147
Calcutta	..	..	42
Cape Town	..	..	868
Durban	..	..	468
,,	Teleg. mat.	..	552
East London	..	..	46
Gothenburg	..	..	49
Korsor.	Sub. cable	..	3,500
Leghorn	..	..	45
Melbourne.	Teleg. mat.	..	287
North Atlantic.	Teleg. cable	..	26,280
Port Elizabeth	..	..	20
Rotterdam	..	..	80
Shanghai.	Teleg. mat.	..	363
Singapore.	Teleg. mat.	..	128
Stockholm.	Teleg. mat.	..	398
Sydney.	Teleg. mat.	..	41
Wellington	..	..	157
Yokohama	..	..	979
Total	..		£35,565

WEEK ENDING JUNE 20TH, 1899.

Amsterdam	..	Value	£40
Antwerp.	Teleph. wire	..	129
Archangel	..	..	51
Auckland	..	..	130
Barcelona	..	..	150
Bombay	..	..	165
Buenos Ayres	..	..	31
,,	Teleg. mat.	..	712
Calcutta	..	..	229
Cape Town	..	..	78
Christchurch	..	..	26
Colombo	..	..	20
Copenhagen.	Teleg. cable	..	4,573
Durban	..	..	1,797
East London	..	..	220
Ghent	..	..	75
Hong Kong	..	..	178
Melbourne	..	..	30
,,	Teleg. mat.	..	1,473
New York	..	..	120
Ostend	..	..	38
Otago	..	..	800
Port Elizabeth	..	..	490
Rio Janeiro	..	..	35
Rotterdam	..	..	20
Rouen	..	..	350
Santos.	Teleg. mat.	..	491
Singapore	..	..	72
,,	Teleg. mat.	..	172
St. Petersburg	..	..	883
Stockholm	..	..	38
Sydney	..	..	472
Teneriffe	..	..	85
Wellington	..	..	68
Yokohama	..	..	29
Total	..		£14,220

Foreign Goods Transhipped.

Colombo.	Elec. fittings	Value	£56
Sydney.	Telephone mat.	..	3,994
Total	..		£4,050

Bankruptcy Proceedings.—A receiving order has been made in the case of B. Wild and J. H. Clark (Wild, Rothwell & Co., general and electrical engineers, Atlas Works, Virginia Street, Southport.)

The first meeting and public examination in the case of G. T. Godfrey, builder and electrical engineer, Balham and Tooting, will be held on June 26th and July 6th respectively. The first meeting will be held at 24, Railway Approach, S.E., and the examination at the Court House, Wandsworth.

In the case of P. C. Pope, electrical engineer, Hapton, near Burnley, upon application, discharge has been suspended for two years dating from May 20th, 1899.

The adjourned meeting of the creditors of Edward Lionel Joseph, electrical engineer, lately managing director of Williamson and Joseph, Limited, Northampton Works, Canonbury, was held at the London Bankruptcy Court last Friday, when a resolution was passed for Mr. B. Dunn, chartered accountant, 10, Coleman Street, E.C., to wind up the estate in bankruptcy, assisted by the following Committee of Inspection, viz, Mr. E. Edwards, Mr. M. S. Rubinstein, and Mr. C. M. Poland. Accounts have been filed showing liabilities £7,618 9s. 1d., and assets consisting of 4,293 £1 shares in Williamson and Joseph, Limited (now in liquidation), and a debt of £5,634 16s. due from the same company. The value of the shares and book debts have yet to be ascertained. The following are the principal creditors, viz:—

UNSECURED.

Aronson, G.,	Bradford	£80
Edwards, E.,	London	47
Hall, W.,	,,	75
Joseph, B. M.,	,,	192
Poland, E.,	,,	230
Rubinstein, M. S.,	,,	140
Sprintz, N.,	,,	13
Trustees of wife's settlement		1,228
Williamson, A. E.,	Guildford	4,825

PARTLY SECURED.

Foster & Cranfield,	London	£112
Metropolitan Bank of England and Wales,	London	200
Rawlinson, C. J.,	London	22
Wederell, T. S.,	,,	400

PREFERENTIAL.

Rates and taxes	£11

Annual Outings.—The employés of the "Robertson" Lamp Factory held their annual excursion to Margate on Saturday last. A party of about 200, accompanied by the managers and heads of departments, journeyed down from Victoria. After dinner the various toasts were proposed, and in replying to the toast of "The Firm," the chairman incidentally remarked that the numbers had more than doubled since the excursions were first started three years ago, and in the same period the output of the factory had increased in the same proportion, this being conclusive proof of the excellence of the "Robertson" lamp.

The annual outing of the employés connected with the works of Messrs. Thomas Parker & Co., Limited, Wolverhampton, took place on Saturday. The party were driven in brakes to Kinver, where a pleasant day was spent.

Books Received.—"The Management of Engineering Workshops," by Arthur H. Barker. (1899). Manchester: The Technical Publishing Company, Limited. 7s. 6d.

Institution of Junior Engineers; Record of Transactions. Vol. VIII. 1897—98 session. 10s. 6d.

"Fire Tests with Floors." "Fire Tests with Ceilings." The British Fire Prevention Committee, London.

The Bristol Tramways and Carriage Company, Ltd., v. The National Telephone Company, Ltd.—In the Chancery Division, on 20th inst., before Mr. Justice North, an action was heard on affidavit evidence brought by a tramways company to restrain the National Telephone Company from laying telephone wires in the street, in such manner as to disturb their tramways, without the leave of the plaintiffs. The question between the parties depended on the construction of clauses in the Telegraph Acts, 1863 and 1878, and the Tramways Act, 1870. The plaintiffs are the owners of an extensive system of tramways in the city of Bristol and neighbourhood, some worked by horse-power, some by electricity. The defendant company are licensed from the Postmaster-General under power to grant licences conferred by the Telegraph Act, 1892. This action relates to the breaking up of the road in St. Augustine Bridge, an open space which is the centre of the tramway system in the city of Bristol. The Telegraph Act, 1863, provides that telegraphs are not to be placed along a street without the consent of the body having the control of the street, and by Section 13 it is provided that where a street is maintainable by a landowner or other person not the road authority, his consent is also necessary. Section 28 of the Tramways Act, 1870, throws the burden of repairing streets between and immediately by the side of the lines of a tramway on tramway companies. Section 32 enacts:—

> Nothing in this Act shall take away or abridge any power to open or break up any road along or across which any tramway is laid, or any other power vested in any local authority or road authority for any of the purposes for which such authority is respectively constituted, or in any company, body, or person for the purpose of laying down, repairing, altering, or removing any pipe for the supply of gas or water, or any tubes, wires, or apparatus for telegraphic or other purposes, but in the exercise of such power every such local authority, road authority, company, body, or person shall be subject to certain restrictions.

By the Telegraph Act, 1878, provision is made that where a body or person has power to refuse consent to the Postmaster-General placing a telegraph line over or under a street or certain other places, the Postmaster-General can require consent to be given on terms to be fixed by arbitration in manner provided by the Act.

Mr. C. A. Cripps, Q.C., Mr. Stewart Smith, and Mr. Pepys, for the plaintiff company, argued that the defendants had no power to interfere with the street under the tramways without the consent of the tramway company; that even if they had the power to compel such consent under the provisions of the Telegraph Act of 1878 in favour of the Postmaster-General they could not do so in a summary manner.

Mr. Swinfen Eady, Q.C., and Mr. Roskill *contra*.

Mr. Justice North, having referred to the section of the Acts mentioned above, said (according to the *Times* report), he came to the conclusion that by reason of the saving of Section 32 of the Tramways Act, 1870, it was not necessary for the telephone company to get the consent of the tramway company before breaking up the street where the tramway was in order to lay their telephone wires. In the result, he dismissed the action.

Changes of Address.—Messrs. Simon, Berry & Co., have removed their offices and stores to larger premises at 78, Upper Thames Street, London, E.C.

Messrs. J. H. Tucker & Co., have removed their London office and stores to 3, Bury Street, New Oxford Street, W.C.

Messrs. Fuller & Co. have been compelled by increasing business to take more extensive premises at 9, Red Lion Court, Cannon Street, E.C., from June 24th, 1899.

The Cruto Incandescent Lamp Agency, Limited, have removed to 2, Tower Royal, Cannon Street, E.C.

From 24th inst., until further notice, Messrs. Crosby Lockwood and Son's trade branch will be 65, Shoe Lane, E.C.; all correspondence, publications and other matters to be addressed to the general offices, 23 Paternoster Row. The removal is only temporary during the rebuilding of 7, Stationers' Hall Court.

Messrs. Crews & Hanford, consulting electrical engineers, are removing on the 26th inst., from Cross Street Chambers to more convenient offices at 11, Blackfriars Street, Manchester.

The Fuller-Wenstrom Electrical Manufacturing Company notify that on and after June 24th, their address will be 9, Red Lion Court, Cannon Street, E.C.

Messrs Gent & Co., have removed their London office and warehouse to 25, Laurence Pountney Lane, E.C.

Charge of Stealing Electricity.—On 16th inst. Luigi Armanni appeared at Bow Street in answer to an adjourned summons charging him with feloniously abstracting and consuming electricity belonging to the Metropolitan Electric Supply Company. The facts have been already recorded in the ELECTRICAL REVIEW. On Friday it was contended for the defence that in the main the company was proceeding on suspicion, and that the suggested fraud was far too crude to be undertaken by a competent electrician such as the defendant. The hearing was again adjourned, the defendant being bound over in his own recognisances in £50.

Committed for Trial.—At the Guildhall on Tuesday, Herbert Adams, 30, electrician, of Bookham Street, New North Road, was committed for trial upon charges of conspiring with another man, not in custody, to obtain large quantities of electrical plant from a French firm of electrical engineers, having offices in the Wool Exchange, by false pretences. Detective-inspector Wise, who had charge of the case, said that although every effort had been made the missing man had evaded arrest.

The Copper Market.—Messrs. H. R. Merton & Co's. circular for the fortnight ending June 15th, shows that during the first half of June the price of G.M.B's. has fallen 15s. per ton, and that since May 15th a fall of £3 per ton has occurred. The stocks of copper are 875 tons less than on May 31st. Both supplies and deliveries are much below the average for the previous 12 months, being 7,139 tons and 8,014 tons respectively. The shrinkage in supplies has extended to *all* countries, the decline in the shipments from Chili being the most noticeable. No doubt the arrivals during the latter part of the month will tend to bring up the deliveries to a more normal figure. The relative prices of copper and aluminium for conductors of equal length and equal sectional resistance, are now represented by

$$\frac{8{\cdot}93 \times 8{\cdot}49 \times 59}{2{\cdot}68 \times 14{\cdot}5 \times 100} = \frac{4\,472}{3{,}886} = \frac{115}{100}.$$

At the price of 8·49d. per lb. copper is therefore still about one-seventh more costly than aluminium, metal for metal, for conductive purposes.

"Duncan's Manual of Tramways, Omnibuses, and Electric Railways, 1899." London:—T. J. Whiting & Sons, Ltd., 3s. 6d.—The time has hardly arrived for the publication of an English electric tramway manual, as the number of electric lines, and consequently the number of officials is comparatively small, though we do not doubt that with the development of electric traction, some such directory or handbook will make its appearance. In the meanwhile the tramway man may turn to this book for financial details of the electrical lines now in operation, and the *personnel* thereof. An examination of the contents, particularly the names of the directors of the various lines now operated by horses, shows to what an enormous extent electrical financiers and engineers are getting the systems of this country under their control. This means nothing short of conversion to electrical traction on all these lines, bringing considerable business to the electrical industry. We have examined with interest the accounts showing the receipts and expenses per mile run, but in too many cases where electricity is employed, the compiler of this manual has met with the same measure of success that others have experienced, these particular items being marked "not obtainable." The few electric lines which have published their costs and expenses, proving how economical in operation, and how popular in working electrical traction is, have, we believe, done great things in persuading tramway authorities, both municipalities and others, to take electrical conversion schemes in hand. It is to be regretted that in a few places it has been considered necessary, for some reason or other, to withhold data as to costs. It is hardly the thing for English engineers to have to quote American results where the circumstances are not on all fours with English practice. The more figures available regarding the working of trolley lines at home, the greater will be the progress of electric traction. The figures which are included are: Blackpool and Fleetwood, traffic receipts per mile run, 1s. 8d., total expenses per mile run, 8·14d.; General Electric Tramways Company (Hartlepool lines), receipts 11·10d., expenses 8·10d.; Liverpool Overhead Railway, receipts (two half years) 24·37d., 25·74d., expenses 15·48d., 15·89d.; Bessbrook and Newry electric tramway (two half years), receipts 19·7d. and 19·9d., expenses 17·26d. and 17·42d.; Blackpool Corporation trams, receipts 16·43d., expenses 10·97d.; Dover Corporation trams, receipts 11·83d.; Leeds city trams, receipts 11·69d., expenses 9·89d. Towards the end of the book there is a directory of directors and officials connected with the various tramway companies of which particulars are given.

Hampstead Vestry v. C. B. King, jun., & Co.—On 14th inst. at the Hampstead Petty Sessions, defendants, electrical engineers, of Heath Street, were summoned by the Hampstead Vestry for "unlawfully connecting a certain electric light line with a line or apparatus belonging to the Vestry" without the consent of that body. Mr. A. P. Johnson, solicitor, Vestry clerk, appeared for the Vestry, and Mr. W. G. Bate, solicitor, appeared for the defence. Mr. C. B. King, jun., and his partner, Mr. Eric Rivers Smith, both stated on oath that permission had been given for them to make the connection by an employé of the Vestry. Evidence was given in denial of this. Mr. Basil Woodd Smith said that under the circumstances only the small fine of 20s. and costs would be imposed.

Liquidations, Dissolutions, &c.—Messrs. J. Moores and H. O. Farrell, (Moores, Farrell & Co., electrical engineers, Victoria Street, Manchester) have dissolved partnership, because the business of the Electrical Inventions and Manufacturing Company, Limited, has increased to such an extent that Mr. Farrell is to devote his whole time to the company as sole managing director.

A petition for winding up the Chitty Dynamo and Motor Company will be heard on Saturday, 24th inst., before Mr. Justice Wright. The petitioners are W. M. Seligmann, A. C. Bean, and M. Codd.

List.—The Cruto Incandescent Lamp Agency, Limited, send us an illustrated price list, with letterpress in French and Italian, giving particulars and prices of incandescent lamps made by them, together with illustrations showing a number of different shapes.

London County Council.—The Council on Tuesday resolved to lend £25,000 to the Fulham Vestry for electric lighting purposes at the rate of 3 per cent., the amount to be repaid within 42 years. Mr. Beachcroft drew the attention of the General Purposes Committee to the memorial which he presented to the Council four months ago from the London Engineering Employers' Association with reference to the Council's form of engineering contract. The speaker stated that he had received several communications on the subject, and he desired to know when the Council might expect a report dealing with the matter. Mr. R. Strong, chairman of the General Purposes Committee, replied that a report on the subject would be brought before the committee next Monday. The Parliamentary Committee reminded the Council that the resolution passed last month, consenting on certain terms to the London United Tramways Company applying for power to use electric traction, provided that the solicitor should prepare the necessary documents to give effect to the resolution. It had, however, been found that the matter could not be carried through otherwise than by amendments in the company's pending Bill. Continuing, the committee said:—

> After several conferences between the Parliamentary agent and the solicitor on behalf of the Council and the agents and solicitors for the company, a set of clauses and a draft agreement have been provisionally arrived at. We think that these documents give substantial effect to the above-mentioned recommendations of the Highways Committee as adopted by the Council.
>
> As the matter is now actually pending in Parliament, we have instructed the Parliamentary agent to withdraw the Council's opposition in the House of Commons to the Bill, provided the clauses and agreement in question are adopted by the company. The matter being important and the circumstances somewhat exceptional, we have given orders for copies of the clauses and agreement as revised by the Parliamentary agent, in accordance with our instructions, to be circulated to the members of the Council.

On the recommendation of the committee it was decided to approve the action taken in regard to the Bill.

National Gas Engines.—The National Gas Engine Company have this week been exhibiting at the Royal Agricultural Show, which closes to-day at Maidstone, seven of their gas engines as follows:—2 H.P. effective; 3 H.P. effective; 3½ H.P. effective driving dynamo; also engines of 4, 6, 11 and 30 H.P. effective.

Smoke Nuisance.—The St. George's Vestry is writing to the Westminster Electric Light Corporation complaining of continued nuisance caused by the emission of steam and grit from the chimney of the Eccleston Place Station.

The St. Saviour's Board of Works has resolved to apply to the High Court for an injunction restraining the City of London Electric Lighting Company from creating or continuing the smoke nuisance, for which maximum penalties have been imposed on two occasions. It is complained that the nuisance has not been discontinued.

Trade Announcements.—We are asked to state that Mr. Alfred Slatter has purchased the Art Metal Works, until lately carried on by Sax, Slatter & Co., Limited, at Peckham, and will continue this business under the name of Alfred Slatter & Co., with head office at Buckingham Chambers, Buckingham Street, Strand. In order to devote his time and energy to this branch of electrical work, Mr. Slatter has resigned his position of managing director to Sax, Slatter & Co., Limited, but retains his seat on the board as a director.

We understand that Mr. T. Herbert Kaye, of 4, Ramsden Street, Huddersfield, accountant, the trustee in *re* James E. Stott & Co., of Byram Arcade, Huddersfield, electrician, in bankruptcy, has disposed of the whole of the stock, plant and fixtures in the above estate to Messrs. Wilson & Graham, Green Street, Huddersfield, electricians.

On account of the large amount of work in hand, Messrs. Harrap, Hewett & Duffield, of 34, Queen Street, have removed to 5, Budge Row. The new premises will suitably accommodate the increased staff for consulting practice. This is continually growing and at present includes lighting and power plants for the Chatham Corporation, the Bedford Music Hall, Messrs. Thorne Brothers, Limited, Messrs. G. H. Leavy, Limited, and several others, also a large electrically driven refrigerating plant for the Birmingham Cold Stores, Limited.

Messrs. Rogers & Co. have opened premises in Paradise Parade, King's Lynn, as electrical engineers, &c.

ELECTRIC LIGHTING NOTES.

Ayr.—The minutes of the Electric Lighting Committee which came up for adoption last week contained some correspondence from Mr. R. Hammond and from Mr. Fuller, the resident electrical engineer, regarding paralleling. Mr. Hammond said that Messrs. Siemens Bros. & Co. had now expressed their willingness, without prejudice, to take back one of the sets of plant, and to allow for the same the full contract price, less £360, in respect of the use of the same over 3½ years. They made this offer conditional upon their supplying two 200-kw. Siemens-Belliss sets, per their quotation of March 14th last. Mr. Hammond pointed out to Messrs. Siemens Bros. that there was not room in the works for two such size sets, and they express their willingness to consider the matter upon the same basis if an order for a single larger set, say, 300 kw., is placed with them. Mr. Hammond says that the tendency in all electricity works is to increase the size of sets, and he feels confident that the time is not far distant when 300 kw. will not be too large a set for Ayr. Mr. Fuller's letter to the Lighting Committee, after criticising the arrangement suggested by Messrs. Siemens, says:—

> As regards immediate and large extensions, my opinion is that we should not think of it at present, but rather wait until the spring of next year, which would give ample time for the makers to deliver before we are likely to require it. Mr. Hammond, it would appear, is of opinion that an order should be placed for either two 200-kilowatt or one 300-kilowatt sets, but I am afraid that he has rather over-estimated the demand upon these works during the next few years. In order that the committee may form some idea as to whether or not extensions should be ordered now, I give below a table setting out the estimated output from these works for the next five years based upon the same rate of progress as during past years:—
>
> Winter 1896, maximum output 108 kilowatts.
> Winter 1897, maximum output 140 kilowatts.
> Winter 1898, maximum output 210 kilowatts.
> Winter 1899, estimated output 270 kilowatts.
> Winter 1900, estimated output 324 kilowatts.
> Winter 1901, estimated output 380 kilowatts.
> Winter 1902, estimated output 450 kilowatts.
> Winter 1903, estimated output 540 kilowatts.
>
> The maximum output for the winter of 1903 would be, I estimate, about 540 kilowatts, as against 625 kilowatts installed at the works, leaving a reserve of 85 kilowatts. From the above it will be at once apparent that we need not order any further extension of plant until, say, the spring of 1900, which would allow of fully two years before it would be required—viz., for the winter of 1902. After considering these figures, I feel sure that you will agree with me that our best plan in connection with the settlement of the old contract would be either of the following, viz.:—(1) To obtain as large an allowance for non-fulfilment of contract as possible; or, (2) to exchange No. 3 plant for two high-speed sets of 120 kilowatts, making the best terms possible, but only taking delivery of the second plant at three years date, and so save unnecessary interest and sinking fund.

After further correspondence it appeared that Messrs. Siemens were very unwilling to quote for a 120 kw. set, as they felt confident that they would never get a second order for so small a set, the demand running for large sizes; and as the main objection to the 300 kw. proposition was that there is no immediate necessity for so large a set, and that the Corporation do not wish to burden their capital account unnecessarily, Messrs. Siemens had intimated their willingness, if the 300 kw. proposition be accepted, to give the Corporation the power to delay taking delivery for three years, or till such earlier date as they may fix, provided 12 months' notice be given. Mr. Hammond had indicated that if this be agreed to he thought Messrs. Siemens could be induced (1) to permit the burgh to retain possession of the balance of the retention money, viz., £618 5s. until the 300 kw. set is delivered, and (2) to permit the burgh to continue using the 100 kw. set until the 300 set is delivered, the burgh paying 5 per cent. per annum for such use. The Committee generally approved of the proposed basis of settlement, but preferred to have a 200 kw. set in lieu of the 300, to be delivered at the end of two years or sooner on giving 12 months' notice, provided Messrs. Siemens can quote a satisfactory price for the plant. The Committee unanimously agreed to ask Mr. Hammond to arrange with Messrs. Siemens on the basis above-mentioned, but to report details before closing, and particularly as to price of 200 kw. set.

Banbury.—A special sub-committee has submitted to the Council, without making any recommendation, a report regarding an offer of the Electrical Development and Finance Corporation to take over the Council's provisional order. The company submitted alternative schemes, the one considered the more favourable by the committee being a suggestion that the Council should carry out the scheme for the borough to the plans and specifications of the company's consulting engineer. The work would not necessarily be done by the company, but tenders could be invited publicly and the works executed at the least possible cost. The initial scheme is estimated to cost £20,000. The report was received, but it seems to be the Council's intention not to act further upon it until further consideration has been given to the matter, and the Council seems to be inclined to consider other proposals from electrical firms. Several speakers advocated drawing the attention of the electric lighting world to the position of affairs through the medium of the electrical journals.

Bermondsey.—The Electric Lighting Committee informed the Vestry at the meeting on Monday that the Bill to confirm the provisional order had been read a second time in the House of Lords and been ordered to be committed. Messrs. Deacon & Co. had submitted clauses for the protection of the London Electric Supply Corporation, stating that if they were inserted the company would withdraw the petition presented against the Bill. Having carefully considered the question, the committee stated that they could not recommend the Vestry to agree to the clauses. The Electric Lighting Committee reported that the London Electric Supply Corporation had appealed to the Board of Trade against the notice given that the Vestry required the covers of street boxes to be constructed of the Patent Safety Tread Company's material in lieu of concrete covers as now fixed. Major Cardew held an inquiry into the matter, and the Board subsequently approved the works subject to the company giving an undertaking to the Vestry to remove the covers and replace them by covers filled with York stone or of the safety head within two months after receiving a requisition to that effect from the Vestry. In commenting upon this decision, the committee observed that this was the second time the Board of Trade had confirmed the objections raised by the Vestry. In a further report the committee stated that Messrs. Kincaid, Waller & Manville had forwarded copy of specification for the lighting of the Town Hall at

a cost of £743. As an expenditure of only £500 had been provided for this purpose in the estimates, the committee intimated that they would report further on the subject at the next meeting.

Beverley.—A member of the Council has given notice of motion to instruct the Gas Committee to consider the electric lighting question, with a view to adopting a scheme.

Bridgwater.—An unsuccessful attempt was made at the last Council meeting to get rescinded a resolution passed at a previous meeting for proceeding with a low tension electric lighting scheme for the whole of the borough.

Bristol.—An interesting contest lasting over several days terminated on Monday in one of the Parliamentary Committee rooms of the House of Commons. The struggle was between the Bristol Civic Electrical Committee and the Bristol Gas Company, and although the proceedings deprived the Municipal Electrical Association of the presence of their president, Mr. Faraday Proctor, at several of their principal gatherings, the gentlemen who expressed satisfaction that his absence was due to so good a cause as a fight with a gas company may derive additional pleasure in the fact that that fight was a successful one. The point was peculiar. The Bristol Electrical Committee's arc lights have displaced a large number of gas lamps, formerly used for street lighting. Scores of principal shopkeepers use electricity for illuminating purposes rather than gas, and lately the Committee have dropped the prices of their current for power purposes, their hope being to get a day load. The gas company, under an old Act, is required to give to the Corporation of Bristol a most favoured customer scale, but the company, under the plea that they wish to develop the use of gas for power and for other purposes than light, desired to abrogate this provision so that they might be free to charge whatever sum they liked to their customers without being obliged to correspondingly reduce the price of gas for public lighting. The Electricity Committee at Bristol saw in the company's scheme a direct attempt to get behind the civic monopoly in the matter of electrical supply. Colour was lent to this theory by the original proposal of the company to include the hiring out of dynamos, &c., as part of their new business. The Lords Committee struck out of the Bill reference to the supply of electrical machinery, but left the company the freedom they desired as to the charge to be made for gas for purposes other than light. This led the Electrical Committee to fight the Bill again when it reached the Commons. In the course of the inquiry it was stated that the Corporation was the largest customer the company had, and that it was so common a condition that Corporations should be supplied with gas on the same terms as charged to the most favoured customer, that 92 precedents could be quoted for it. The company were—the counsel for the Corporation argued—trying to get out of a bargain which had been in force ever since 1853. The company had not suffered by reason of the introduction of electric light; the directors had paid the maximum dividends allowed, and had filled their reserve fund. The company could, of course, reduce the price of gas for power or any other purpose, but if they did the Corporation must also reap the benefit by having the reduction applied to the gas used for public lighting. If the Bill was passed there was, the learned counsel contended, nothing to prevent the gas company selling gas for power purposes at a loss in order to compete with electricity, the loss being charged to the ordinary lighting consumers and to the Corporation as managers of the street lighting. The argument for the company was that new conditions had arisen in that the Corporation was proposing to supply electricity for power purposes at 1½d. per Board of Trade unit, which would prevent the gas company competing with them unless they had the power of differentiating their charges as between motive power and lighting purposes. Although it was true the House of Lords had struck out the power to supply dynamos, it was reasonable if a man did not want to take electricity from the Corporation, but wanted to instal it in his own works, that the gas company should have the power to supply him with the machinery or the installation. The gas company was pleading, it was said, for free competition. The Parliamentary Committee at the close of the hearing declined the company's request to repeal this old condition. The Bill contained a variety of other provisions, and the preamble was considered proved.

Bootle.—Last week Councillor I. A. Mack, as chairman of the Watch Committee, submitted its fourth report on electric lighting. He said the first part of the electric lighting scheme sanctioned by the Council in 1897 had been almost completed. According to the last Council meeting, there seemed to be an impression amongst the members that the Watch Committee had exceeded the powers granted to them by the Council, but he could assure them that the committee had not erected a single lamp or laid a main without the entire support of the Council. The committee was convinced that the cost of the scheme would not in any way be excessive. They had been at a great disadvantage through the delay in the opening of the generating station, the result being that they lost nearly a season's supply. So far as public lighting was concerned, they proposed to go on with the scheme and supply the current to customers, with a view of making it remunerative to the Corporation.—Dr. M'Murray seconded the motion.—Alderman B. S. Johnson proposed an amended motion, to the effect that recommendations 2, 3 and 5 in the report should be adopted, that a special committee should be appointed to investigate and report upon the methods and cost of the public lighting of various towns, and pending the receipt of the report, certain recommendations be not approved, excepting only the sum of £1,000, the amount required for the increase of the station plant. The amendment was defeated by a majority of three votes, and the report was adopted with the exception of its recommendation to appoint a borough electrical engineer at £400 per annum.

Bradford.—The Board of Guardians have decided to take steps to obtain the sanction of the Local Government Board to the fitting up of an electric plant at the Workhouse, in accordance with a report presented by a sub-committee.

Bude.—The question of the electric lighting of Bude is for the moment complicated by a proposal to transfer the local government from the Parish Council to an Urban District Council. Apparently there is a unanimous feeling in the parish in favour of lighting the streets by electricity, but there is some reluctance on the part of the Parish Council to pledge their successors to a definite scheme. However, the negotiations with the company are being continued, and if the Parish Council do not come to an agreement, the District Council will be in possession of the information, which will enable them to determine the question immediately they assume office.

Carlisle.—For a supply of coal for the electricity works, a 12 months' contract has been given to Messrs. Thompson & Sons, at 7s. 6d. per ton.

Chesterfield.—Last week the Council discussed a recommendation from the Electrical Energy Committee that, subject to future arrangements as to details and the approval of the Local Government Board, the tender of the Westinghouse Electric Company of £12,979 to supply a complete electric lighting installation be accepted, that the company be requested to at once prepare plans and specifications to be submitted to the Local Government Board; and that it be an instruction to the town clerk to apply to the Local Government Board for sanction to a loan of £15,000 wherewith to carry out the scheme.—Councillor Markham moved the rejection of the recommendation, which called, he said, for careful consideration. For him it was rather a difficult question, inasmuch as his firm had been concerned in an offer to provide the town with electricity. The quotation his firm gave the Corporation was very much lower than the Corporation could possibly hope to beat for years to come. There was no necessity at present to introduce electric lighting. Electricity was as yet in its infancy, and there would be such developments as would soon send their coal pits and things of that kind to the wall.—Councillor Whitelam seconded.—At this stage the meeting adjourned for a week.

Chislehurst.—The Parish Council have accepted the offer of the Electric Light Company to supply the lamps in the Upper Borough, where cables are not laid, with oil as at present at 45s. per lamp, and to substitute electricity as soon as possible. In those roads where cables are laid the electric current is to be supplied at a cost of £3 per lamp.

Edinburgh.—The Electric Lighting Committee recommend the acceptance of estimates in connection with the Dewar Place power station for the extension of the boiler house by Messrs. R. Thorburn & Son, at about £5,000, and for the supply of fans, &c., by Messrs. Heenan & Froude, about £4,000.

Electric Lighting (Clauses) Bill.—In the House of Commons on Tuesday, on the order for the second reading of this Bill, Mr. Bryce said it was a very useful measure, and likely to be of considerable public convenience. He believed that its provisions did not substantially alter the existing law, which had been in force for a number of years. Mr. Ritchie (Croydon) said the right hon. gentleman had given a correct description of the Bill. The Bill contained nothing that was novel, but its operation would conduce to a great saving of time and cost. The Bill was read a second time.

Enfield.—Mr. W. Pressland has written to the District Council, drawing attention to the Board of Trade's intention not to allow transfer clauses in provisional orders in future, and emphasising the fact that if the Council applies for an order it will be compelled to carry it out without the assistance of a company.

Glasgow.—At a recent meeting of the Corporation the minutes brought up by the sub-committee on electric lighting of the city contained the following:—If the Watching and Lighting Committee resolve upon an extensive scheme of street arc lighting, it may be possible, by grouping several circuits of arc lamps at distributing centres for various districts, to lessen the cost of labour, and, consequently, to still further reduce the price to be charged for each lamp. It is, however, impossible, at present, to indicate what this further reduction might be. The clerk reported having forwarded to the inspector of lighting, for his consideration, a copy of the foregoing minute, so that when reporting to the sub-committee on the proposed lighting by electricity of Saltmarket, Albert Bridge, Crown Street and Cathcart Road to Dixon Avenue, he might deal with the question of the cost of such lighting on the basis of the charges specified in said minute of the electricity department. Mr. Primrose said that the committee were considering a very extended scheme of electric lighting for the city. A complete proposal would be put before the Council at an early date. It would contain the comparative cost of gas and electric lighting.

Hyde.—The Council last week, after receiving a report of a sub-committee which has visited electricity works at Blackburn, Bury, Burnley, Nelson and Manchester, has resolved to apply for a provisional order. The report of a consultant as to area of supply has been approved. It is stated that the Council intends putting in a plant large enough to meet all requirements for years to come, other towns having made a mistake in going to work in a niggardly manner.

Ilfracombe.—The General Purposes Committee, after a conference with Mr. Trentham, electrical engineer, has requested him to proceed with plans for an installation for the town.

Leamington.—The solicitors to the Midland Electric Lighting Company have addressed a letter to the town clerk calling attention to the "serious difficulties which must arise" if the Cor-

poration are unable to come to an immediate decision on the course they intend to take in relation to electric lighting in Leamington. They point out that at the recent inquiry it was admitted that a considerable sum must be spent at once in order to maintain an adequate service for the consumers, and that the company could not be expected to make such outlay in the present state of uncertainty. Unless, therefore, the interests of consumers were to be seriously prejudiced, the Corporation must either give immediate notice of their intention to acquire the undertaking under the arbitration clause inserted by the Board of Trade in the Corporation Order, or formally announce their intention not to exercise such right.

Llanelly.—The Highways Committee has advised the Council to discuss the question of tenders and offers in regard to electric lighting before considering certain proposals made by the gas company.

London, E.C.—The *City Press* says those who have studied the vacillating and mysterious policy pursued by the Corporation over the electric lighting question will not be surprised to learn that the inevitable has happened, namely, that the City of London Electric Lighting Company has issued a writ against the Corporation, declaring that the existing contracts are valid and subsisting. Costly litigation is imminent unless the Corporation is prepared to modify its policy and submit the whole question to arbitration.

The City of London Electric Lighting Company has written to the town clerk for the purpose of dispelling the impression that prevails among consumers that they will have to incur expense in connection with the changing over from low to high voltage supply. The company undertakes to bear the expense of whatever alterations may be necessary.

Luddendenfoot.—The District Council has discussed the electric lighting proposals put forward by the Sowerby Bridge District Council to apply to the Board of Trade for a provisional order, and has decided to oppose the application of Sowerby Bridge.

Morley.—Mr. Herbert Brewett, the present assistant electrical engineer, has been appointed borough electrical engineer.

Romford.—Messrs. Drake & Gorham have just completed the work of installing the electric light at Messrs. Ind, Coope and Co's brewery. The works are capable of dealing with 2,000 16-C.P. lamps, and 19 main circuits are connected to the switchboard, these being capable of distributing light to the majority of the hotels and inns belonging to the firm, which are situated in the town, as well as to various private business places. The current is generated at 210 volts.

Sheerness.—The Urban District Council has had under consideration a proposition by Mr. Councillor Fooks for introducing the electric light into the town. Most of the influential members of the Council are large shareholders in the gas company, so that a big fight is expected.

Sheffield.—St. Marie's Church (Roman Catholic) has been fitted up for electric lighting, supply at 200 volts being taken from the Corporation mains. The aisles are lighted with 11 6-light wrought-iron electroliers, fixed to wrought-iron brackets swung between the arches. The nave is lighted with five 5-light wrought-iron electroliers, also the baptistry and the sundry chapels. The chancel is lighted with a handsome 24-light electrolier, and 12 screen lights. The extensive sacristies are also lighted throughout. The main switchboard is very handsome, and consists of six panels of enamelled slate, mounted in a polished walnut case, with 26 D.P. fuse ways and 32 switches. The whole of the work is done on the "Simplex" conduit system, with junction boxes at every fitting. The electroliers were designed by Mr. Hadfield, architect to the church, in conjunction with Mr. J. G. Burchell, A.I.E.E., electrician to Messrs. John Dewhurst & Son, Sheffield, who have carried out the whole of the work, including the making of the fittings. Messrs. Dewhurst have several other large contracts on hand, both for lighting and power.

Shoreditch.—The Vestry on Tuesday discussed for a long time a motion by Mr. H. E. Kershaw proposing the recision of a recent minute, "That in future no member of the Vestry shall occupy the chair of any Committee more than two years in succession." In proposing the motion the speaker (who has been relegated to the position of vice-chairman, with Mr. N. Moss as chairman, of the Electric Lighting Committee for the ensuing year) stated that he could only accept the minute as a punishment for well-doing. No two men on the Vestry had spent as much time and shown as much evidence of ability as Mr. Winkler, the late chairman of the Works Committee, and himself. He was prepared to say that no electric lighting undertaking in England had been carried on with so much success as the Shoreditch installation. They were now embarking upon a large extension, and the man who knew the most about it—well, the one who had gone through the whole management from the inauguration of a new station, was cast aside and another gentleman appointed. That gentleman was of undoubted ability, but he would have to go through the experience of the former chairman of the Lighting Committee, and in two years' time he would also have to be thrown out. That was a punishment and a preventative against any member of the Vestry putting his best efforts into the work of the board. The resolution simply played into the hands of the officials, and the curse of municipal work was officialism. It was a vote of censure upon committees, and he hoped the Vestry would prevent a recurrence of the ridiculous anomaly by rescinding the minute.—Mr. W. Johnson having seconded the motion, a long debate ensued, in the course of which no further support was given to the motion. On being put to the meeting only 11 members voted for the recision and about 70 against, the motion being lost by a large majority.

South Westmoreland.—The Rural Council has received a letter from the Board of Trade revoking the order granted to the Windermere Electricity Supply Company as to the whole of the area of supply affected thereby, except that included in the urban districts of Bowness, Grasmere and Windermere, and the parishes of Langdale, Rydal, Loughrigg, Troutbeck, Applethwaite, Hughill, Over Staveley, Nether Staveley, Undermillbeck and Crook, in the South Westmoreland Rural District, and Claife and Hawkshead in Ulverston Rural District.

Southampton.—The electrical engineer has reported that 717 8-C.P. lamps were connected during May. The number of units sold was considerably larger than in the same month in 1898.

Stafford.—Alderman Wright states that the consumption of electricity has so increased that the Gas and Electricity Committee have this year been able to make the first payment of £72 towards a capital expenditure of £560. They have also paid off some £2,000 of borrowed money.

Tavistock.—The Council last week had before it an electric lighting scheme introduced by Mr. Jabez Petherick, with the concurrence of the Lighting Committee. The cost he estimated at £4,661. He puts down the annual receipts at £1,401 and the expenses at £1,155, including £300 interest on sinking fund at 6 per cent., estimating an annual profit of about £250. The motive power would be partly steam and partly water. He recommended the borrowing of £5,000, so as to leave a margin. He moved that the Council apply to the Board of Trade for a provisional order to instal the electric light at Tavistock. The clerk stated that the motion was out of order, as it must be proposed at a special meeting. The matter was adjourned for a month.

Tewkesbury.—The Urban District Council is taking steps to ascertain the cost of a provisional order and of an installation.

Wellingborough.—The Council sitting in committee last week considered the proposals of the Electrical Power Distribution Company, Limited, Mr. Madgen appearing on behalf of the company. A report was also before the committee from Messrs. Clark, Forde & Taylor.

Weston-super-Mare.—The Urban Council has approved the draft memorandum and articles of association of the Weston-super-Mare and District Electric Supply Company, of which the proposed first directors are Messrs. W. L. Madgen, Raworth and Sellon.

Yarmouth.—At the last meeting of the Town Council it was reported by the electrical engineer that the cost of production of electric light was steadily decreasing, the saving for the year ended May 31st being 20 per cent. In compliance with numerous requests from customers, he recommended the use of the Brighton system of charging for current, the first hour to be charged at the present rate of 6d. per unit, and for all time after a reduced charge of 3d. per unit for customers consuming more than 4,000 units, and 4d. for those consuming less than 4,000 units per annum. Sir W. H. Preece, the consulting electrical engineer, wrote that it was necessary that additional lighting plant be ordered, and he recommended an immediate outlay of £2,000 on a 150-kilowatt dynamo, and £2,000 for 200 house connections. The Electric Lighting Committee recommended that the Local Government Board be asked to assent to a loan of £27,000 for extensions. The cost of production for the year ended March, 1898, was 2·98d. per unit, and for the year ended March, 1899, 2·39d per unit.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Blackpool.—It is stated that the conversion of the Promenade electric tramway from underground conduit to overhead trolley system has now been completed, and only the Board of Trade inspection and approval is necessary before cars are run.

Brighton.—At the meeting of the Council on the 15th inst., Alderman Sendall, in moving the adoption of a committee's report, recommending that application be made for Parliamentary powers to carry out a system of electrical tramways, said the leading municipalities of England had municipalised their tramways, or were about to do so. Some of the routes proposed would be practically impossible for horse traffic. He alluded to the system at Halifax, which lay in a hollow, being surrounded by hills very much higher than Brighton, with gradients very similar. The cars were driven up these gradients with the greatest possible ease at any pace. What was, perhaps, far more important, was that they came down exceedingly steep gradients with perfect security and ease. The committee were unanimous that the trolley system was the most perfect, economical, and efficient. If there was one thing that had been wanting in Brighton for some years past, it had been vehicular accommodation from the town to the surrounding hills. By this scheme they proposed to afford the accommodation, and more than that, they proposed to give facilities to the population in the

valleys round about to come to and from their business, and from the centre of the town. As a stronger reason for the adoption of the scheme, he expressed his belief that if carried out, it would result in the artisan population, and other sections also, being sent from the congested portions of the town to the breezy Downs. If the system were carried out building operations would, he believed, be extended in the outskirts of the town. He claimed that the routes were equitably distributed over the borough, the Committee having endeavoured to meet the needs of every district and every class. The length of the proposed routes was about nine miles, and on the assumption that four of the nine miles would be laid with double lines that would make 13 miles of permanent way. This, including concrete foundations and wood paving between the rails, would cost about £5,000 per mile, which would give them a total of £65,000. The electrical equipments, including steel poles, they estimated at about £2,000 per mile, making, in all, £26,000. The cost of repairing sheds, estimated for 40 cars, would be £13,000, and it would be necessary to equip these sheds with proper appliances for repairing purposes, which would cost £2,000. It was estimated that 40 cars would give an efficient service. The cost for each would be £600, which would amount to £24,000 for the whole number; with another £10,000 added for incidental purposes, the total was £140,000. After careful consideration, the Committee were of opinion that they would do wisely in bringing the electrical power from the Corporation electrical works. The Committee had not seen anything during their experience, or from their inquiries, which led them to doubt that the tramway service would be other than their electric light service—a profit-bearing investment to Brighton. An amendment to a detail of the scheme found only three supporters. After further discussion, Alderman Reeves said he had visited Leeds and was thoroughly disgusted with the tramways there, considering them an intolerable nuisance. There was intense vibration from 11 o'clock at night until 5 or 6 o'clock in the morning, which was destructive of the peace and comfort of everyone. It was fortunate for Brighton, in his opinion, that this matter had to be fought in the House of Commons, and by that time he had no doubt the Council would have simmered down to its usual common sense and judgment, and no doubt the House of Commons would help them to arrive at a proper conclusion. Alderman Davey, in supporting the report, said that one electric tramway in Leeds was practically noiseless, and if they could have such cars in this district he was satisfied they would do an immense amount of good to Brighton. Alderman Sir John Blaker said that Leeds was a pioneer in the tramway system, and some of the cars were obsolete. He would rather see light tramcars passing down the streets of Brighton than cumbersome omnibuses. The report was then adopted *nem. dis.*

Bradford.—The Select Committee of the House of Commons, presided over by Mr. Molloy, sat on Wednesday last week for the purpose of discussing the clauses of the Bradford Tramways and Improvement Bill, the preamble of which was held proved before the adjournment for the Whitsuntide recess. Mr. Fitzgerald, on behalf of the Shipley District Council, opposed the clauses of the Bill relating to the inclusion of the Urban District Council of Shipley, and the Urban District Council of Buildon, in that borough, but the committee decided to uphold the agreement which had previously been before them. Mr. Freeman said that the promoters were asking to be allowed a period of five years for the construction of tramways, which was longer than the period usually allowed by Parliament. Evidence would be given to show why five years was asked for. Mr. J. H. Cox, the Bradford city surveyor, stated that some of the tramways proposed were to be made in connection with existing tramways which were under lease for 3½ years. It would, therefore, be impossible to make the connection under a period of five years. Other tramways were to be made in connection with the street improvements contemplated, and could not be commenced until these improvements were effected. Three years were taken for the purchase of land. In other cases there was exceptionally heavy masonry to be dealt with. The Chairman: Do you want five years for the construction of the tramway from the boundary of Bradford to the boundary of Leeds? Mr. Freeman gave an affirmative reply. Witness: That will be worked by electricity. It will not run in connection with a tramway that we do not acquire until the lease has run out. The Chairman: Will the tramway be worked under this Bill or under the light railway powers? You have made an application to the Board of Trade for their consent, I understand. Mr. Freeman: That has not been obtained yet. The Chairman: Do you intend to work the tramway under the powers of this Bill or under those from the Light Railway Commissioners? Mr. Freeman: If we can do it we shall work under the light railway powers. If the Board of Trade confirm the powers we shall be able to work under them. But the clauses in this Bill are a safeguard to make sure that we shall be able to work the tramway. If we can enter into an arrangement with the existing tramway company to enable us to start running without delay we shall do so in the interest of the public. These and other clauses were adjusted, and the Bill was ordered to be reported for a third reading.

At a meeting of the Tramways Committee the other day, the returns showing the results of the working of the electric tramways for the fortnight ended June 11th were presented. On the Bolton section 4,828 miles have been run, and the receipts amount to £259 14s. 9d., which is equal to 12·91d. per car mile. The total receipts since April 1st amount to £1,283 14s. 4d., or 12·18d. per car mile. On the Horton section during the past fortnight 9,017 miles were run, and the receipts were £530 12s. 10d., which is equal to 14·12d. per car mile. The total receipts since April 1st amount to £2,450 8s. 11d., which is equal to 15·77d. per car mile.

Chester.—In a report to the Council Improvement Committee the city electrical engineer, Mr. F. Thursfield, details the advantages and disadvantages of the several systems of electric traction. He favours the overhead trolley for Chester, adding:—

> But the fact remains that the architectural features of the streets are of paramount importance in Chester, and it is for the Committee to decide whether they will adopt a system which some people will for a time consider a disfigurement, but to which in every other town they have quickly become reconciled; or whether they will sacrifice this (beyond question commercially the best) system, and adopt some other more expensive scheme involving greater difficulties. If the Committee consider that the objection to the overhead line is insuperable, in spite of the opinions quoted above, I would suggest that a short length of open conduit be laid in the centre of the town, say, from Frodsham Street to the fountain, the remainder being on the overhead trolley system. There should be no difficulty in keeping a short length of conduit in order in the centre of the town where the road is paved. The cost would not be prohibitive, and by adopting the overhead system for the outskirts, which is by far the cheapest system, the Corporation would be in the position to avail themselves of any improved system which may be developed in the future with the least possible sacrifice of capital. It only remains to add that if the Committee contemplate acting on either of the suggestions contained in this report, they should come to some arrangements with the Lighting Committee, who are now considering the question of laying cables along Hough Green, so that the necessary feeders for supplying the tramways may be laid at the same time, and so that the posts selected for the street lighting may be suitable also for carrying the overhead line and placed in suitable positions. It would also be advisable to take the matter up with the National Telephone Company at an early date, to induce them to run their wires only at right angles across the streets, and to bunch them together as far as possible. By doing so the necessity for guard wires would be greatly reduced.

The expenditure for permanent way and cars common to whichever system the Council may adopt, is estimated at £16,450. The difference in the cost of the respective systems, which are given as follows in Mr. Thursfield's estimates:—Closed conduit—£40,640. Open conduit—£49,960. Accumulators—£36,630. Overhead trolley system—£25,430. Combined overhead trolley and open conduit systems—£29,150. The cost of running the different systems is also estimated as follows:—Closed conduit, 9d. per mile—£5,625 per annum. Open conduit, from 5d. to 7d.—£3,125 to £4,375 per annum. Accumulators, 15d—£9.375 per annum. Overhead trolley, from 4d. to 6d.—£2,500 to £3,750; and horse, 10d.—£6,250 per annum.

Clacton.—An Essex newspaper says that the Council has refused permission to the electric traction company to construct tramways in the town. The writer anticipates that the company will shortly apply for power to run a coast railway to Frinton or Walton over the beach.

Croydon.—At a special meeting of the Croydon County Council on Monday it was resolved to purchase by agreement the undertaking of the Croydon Tramways Company for the sum of £50,000. An amendment to take it over, under compulsory powers, by arbitration was defeated by 33 to 10; and other amendments to reduce the price to £40,000 and to refer back the report were also lost.

Dudley and Stourbridge.—Towards the close of last week trial trips of the new electric cars were made on this line, and other trials have been arranged. These, it may be stated, are preparatory to the Board of Trade inspection, and it is satisfactory to be able to state that so far the trials have been all that could be desired. The sanction to use steam power expires about the first week of July, and the public, therefore, are looking forward to the new mode of traction being in full working order by the middle of next month.

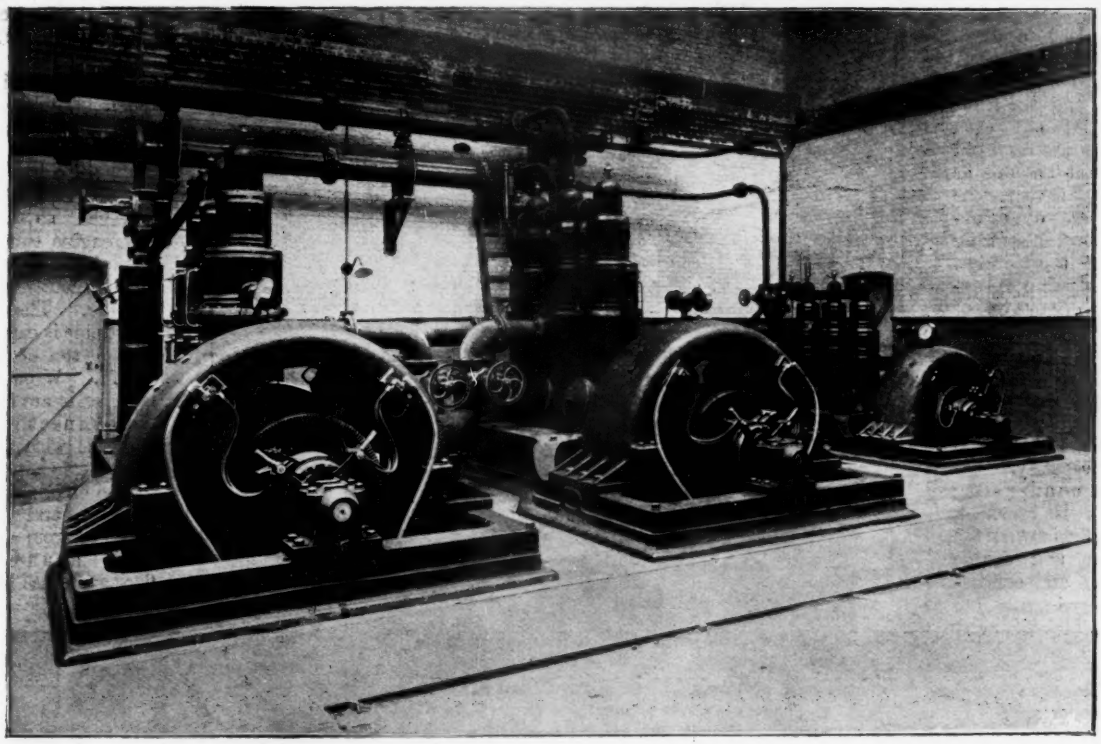
Huddersfield.—On behalf of the Board of Trade, Major Cardew, R E, held an inquiry at the Town Hall on 13th inst. respecting the application of the Corporation for sanction to borrow £47,782 for the purpose of equipping a portion of the tramways for electric traction. The town clerk said that it was the intention to convert three sections of the tramways system from steam haulage to electric traction. The first section—from Salendine Nook to Oatlane—had already been constructed, and the sanction of the Board of Trade obtained for its use as a tramway. The second section was from Paddock Head to Quarmby Clough, and the third from Longroyd Bridge to the borough boundary at Marsden Road. These had not yet been constructed, but the materials were on the ground, and work would be commenced in a few days. The power station would be built large enough to meet more than the requirements of merely the three sections in question. It would be built on a site at Longroyd Bridge, and directly in the centre of the tramways system. The Corporation desired to borrow £8,000 for 30 years for the power station, £17,120 for 25 years for electrical equipment and plant, £11,160 for 25 years for overhead equipment, and £11,500 for 15 years for 23 cars. The present capital of the tramways undertaking was £156,500, and in regard to running powers, which were gained in 1882, the Huddersfield Corporation were the pioneers. In reply to the inspector, Mr. Lloyd said they would have to go to Parliament direct for the borrowing powers respecting the other sections. In concluding the inquiry, Major Cardew expressed the opinion that it was a wise thing to proceed with the electrical equipment of the whole of the tramway system at Huddersfield. He thought there was very little doubt that after the introduction of electrical traction, they would find an enormous increase in the use of the trams.

A proposal was to be made at the Corporation meeting on Wednesday for the promotion of a Bill in the next session of Parliament empowering the Corporation to work by electrical traction in connection with the borough tramways, any tramways laid by urban district councils outside the borough, should that be desired by them and approved by the Corporation.

(*Continued on page* 1029.)

THE NEWINGTON VESTRY ELECTRICITY WORKS.

The history of the electric lighting of the parish of St. Mary is one long record of struggles with adversity and vested interests. So long ago as the year 1883, the Vestry endeavoured to acquire powers to supply electricity, but was thwarted by the opposition of influential ratepayers. For this cause, the London Electric Supply Corporation was permitted to obtain a provisional order unopposed, and began to lay down mains in the district in 1891. The Vestry opposed applications made by the County of London Electric Lighting Company, Limited, in 1892; by the County of London and Brush Provincial Electric Lighting Company, Limited, in 1894, 1895, and 1896; and by the Capital and Counties Electric Supply Company in 1895.



General View of Engines and Dynamos.

The Board of Trade held inquiries in 1896 and 1897, but it was not until the matter was brought before a Committee of the House of Lords in August, 1897, that the Vestry was finally successful in obtaining a provisional order, at a total cost of over £1,000. Messrs. Kincaid, Waller & Manville were appointed consulting engineers, and prepared plans and specifications for a station capable of supplying current to 40,000 8-C.P. lamps. The capacity of the station, now nearly completed, is at present about 10,000 lamps, of which over 3,000 have already been applied for. The amounts of the various contracts were as follows:—

	£	s.	d.
1. Buildings and chimney shaft	12,928	0	0
2. Engines, dynamos, public lighting plant, &c. ...	8,975	0	0
3. Boilers, pumps, steam and exhaust pipes, water tank, condenser, economiser, &c.	9,348	0	0
4. Mains £6,895 10 0			
Conduit and junction boxes ... 2,186 9 6	10,881	19	6
Trenching to date (by Vestry) ... 1,800 0 0			
5. Main switchboard and instruments 1,457 0 0			
Storage battery 900 0 0	2,357	0	0
6. Electric light installation in station	259	12	0
Total	£44,749	11	6

Works.

The buildings, which are situated near the centre of the district supplied, comprise, in addition to the works proper, roomy and well-lighted offices, test room, chief and assistant engineers' rooms, and a store room; there is also a mess room for the men, and a store room near the coal bunkers.

The boilers are of the Babcock & Wilcox type, four in number, and are installed in a large and lofty boiler house with a glass roof, which can be opened for ventilation; ample space is provided for six more boilers. Each boiler contains 90 tubes, 4 inches in diameter, arranged in nine sections, and has a grate area of 39 square feet, with 2,010 square feet heating surface, giving an evaporative power of about 6,000 lbs. of water per hour. Besides the usual fittings, a Hopkinson high and low water alarm is fixed on each boiler.

Mechanical stokers of the Vicars type are employed, driven by a 10-H.P. Lundell motor through worm gearing running in an oil-bath; the motor armature is provided with two commutators, and the speed is regulated by a series-parallel controller, with connections to the 440-volt mains, so that several speeds may be obtained with high efficiency. A similar motor is provided as a stand-by.

The coal bunkers extend along the whole of one side of the boiler house, and a siding from the London, Chatham and Dover Railway is carried overhead, affording a ready means of delivering the coal to the bunkers without handling it. From a funnel-shaped hopper in the floor of the bunker the coal is raised by an elevator to the level of the top of the boilers, and is carried to the hoppers of the automatic stokers by worm conveyors; the conveyors and elevator are driven by the Lundell motor which also drives the stokers. Our illustration of the boilers shows the motors and worm gearing approximately in place, but the conveyors are not yet erected.

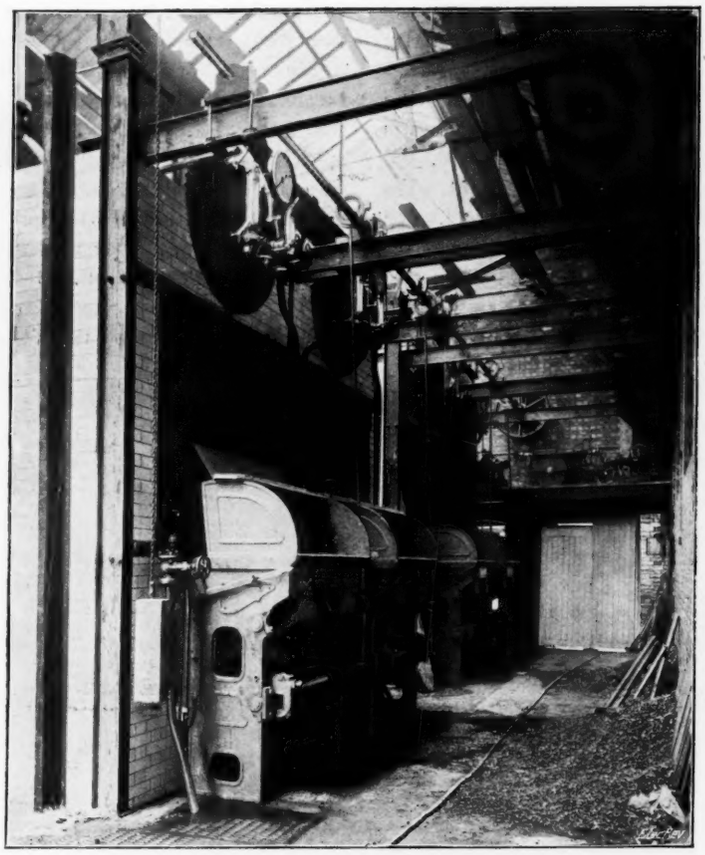
A Green's economiser is in use, with 192 tubes 9 feet long

and 4 inches diameter, in two sections; the scrapers are driven by a 1-H.P. motor of the British Thomson-Houston enclosed type.

The shaft is 123 feet high and 6 feet in diameter, octagonal in shape, and is lined up to a height of about 45 feet.

We give an illustration showing the pump room, in which there are two feed pumps, one being driven through single reduction gear by a small vertical engine, the other by a Lundell motor with double reduction gear and series-parallel control. The feed and steam pipes are in duplicate, and the three barrels of each pump are arranged so that any one or two of them can be cut out of action without interfering with the others. Each pump is capable of delivering 1,750 gallons per hour. There is a large storage tank on the roof of the pump room, of about 12,500 gallons capacity.

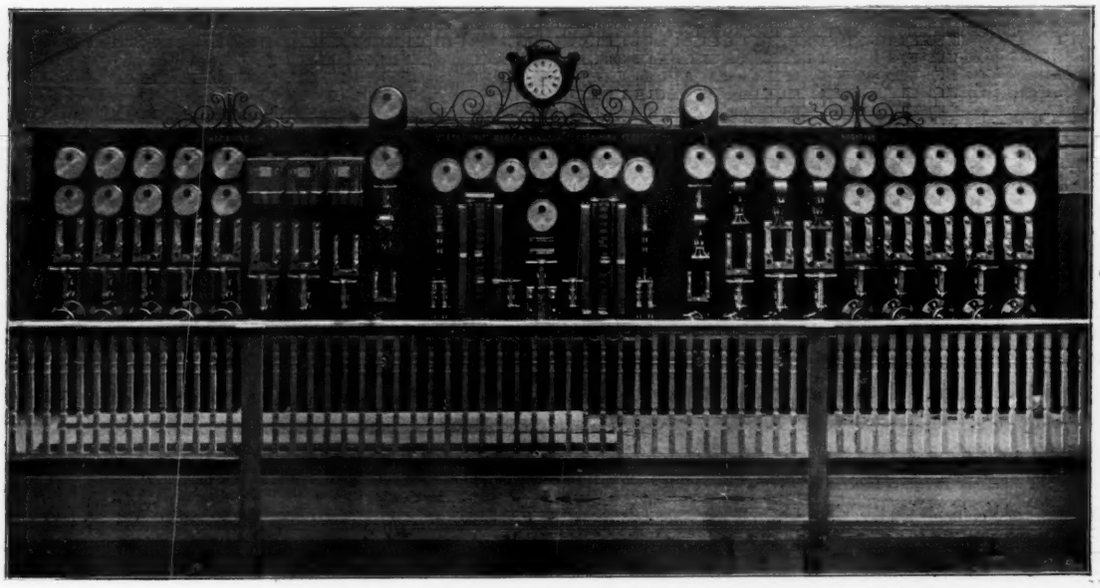
A condensing plant is provided, situated between the boiler and engine rooms, and consisting of a surface condenser and a combined air and circulating pump, which, as well as the feed pumps, was made by Messrs. Hayward Tyler & Co. The condenser is able to deal with 4,000 lbs. of steam per hour; the pumps are driven by a 6·5 H.P. Lundell motor. The water supply for the condenser was to have been obtained from the public baths which adjoin the works, but it seems doubtful whether this will be available, owing to some disagreement between the respective committees; if necessary, a cooling tower will be erected for this purpose.



Boilers and Mechanical Stokers.

The main steam pipes, which are of wrought-iron, cross the condenser room, passing through separators just outside the engine room. The steam and exhaust pipes are in duplicate throughout, the latter being arranged so that any engine can be worked either with or without condensing. The exhaust pipe is carried to the top of the shaft. Wrought-iron bends are used to connect the engines with the main steam pipes.

The engine room is lofty, and well lighted from the roof; abundant floor space has been provided for future extensions. The generating plant, which we illustrate, consists at present of two 165-kw. direct cur-

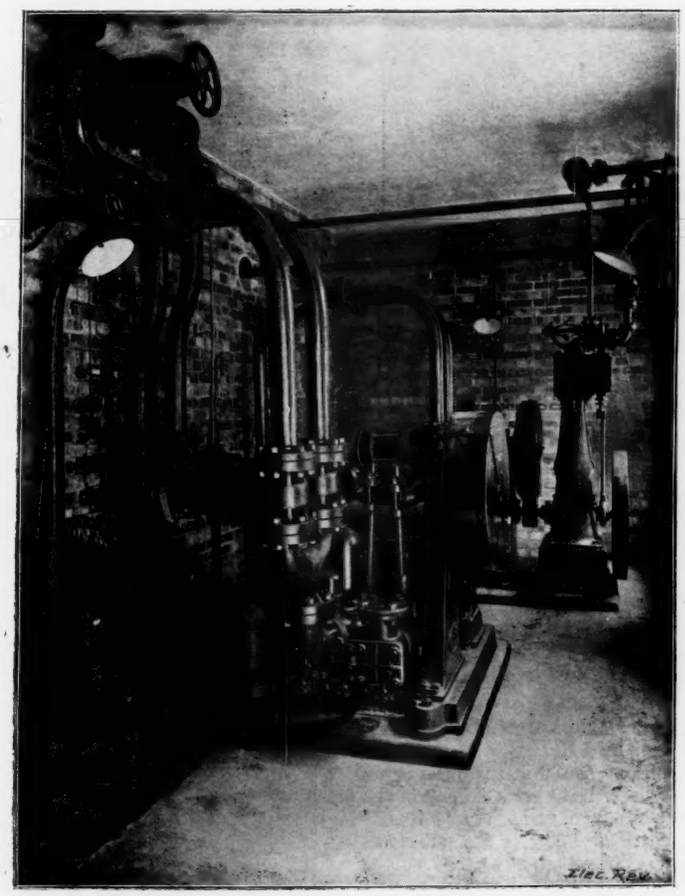


Switchboard.

rent dynamos, coupled to Willans three-crank compound engines and running at 350 revolutions per minute, and one 82-kw. dynamo coupled to a similar engine, running at 450 revolutions per minute.

The dynamos were manufactured by Messrs. Johnson and Phillips, and are of the four-pole type, with circular yokes. As will be seen from our illustration, the machines have a massive and workmanlike appearance, and are so designed that the armature is readily accessible on removing the upper half of the yoke. The pole pieces of the field magnets are divided into four parts by deep slits running parallel to the armature shaft; the field magnet winding is arranged with coned ends, exposing a large surface for cooling. The armature is wound with solid copper bars in two layers, in open slots; the end connections are of the cylinder type, and each section of the winding consists of two bars, which are bent to shape and insulated before being assembled on the core. The armature core and the commutator are mounted on a cast-iron spider, which is provided with extensions to support the end connections, and is keyed to the shaft.

The arms of the spider are so shaped as to maintain a current of air through the core, in order to carry off the heat which is given out. The makers state that the temperature rise of these machines after a run of six hours at full load is very small. The commutator-end bearings are provided with automatic ring lubrication. Carbon brushes are used on the commutator. The field magnet excitation is derived from the 220-volt mains, on either side of the system, and can be varied so that the terminal pressure at full load may be adjusted to any value between 450 and 500 volts without altering the speed. The combined efficiency of the 165-kw. sets at full load, when tested at Messrs. Willans & Robinson's works, was found to be 84·4 per cent. when running non-condensing, although the consulting engineers only required 80 per cent. The engines are capable of giving 25 per cent. more power when required.



Pump Room.

A small coupled plant, at present employed in lighting the public baths, is to be put down in the condenser room as soon as the baths are lighted from the mains, and will be used as a balancer and for charging the batteries.

The travelling crane was manufactured by Messrs. Carrick and Ritchie, and is capable of lifting 15 tons.

Battery.

The battery was manufactured by Messrs. Pritchetts and Gold, and consists of 258 cells of 19 plates each in glass boxes, with a normal output of 50 amperes for nine hours, or 100 amperes for three hours. The plates are formed by the Planté process. The cells are arranged in three tiers in a very small battery room, which is, however, well ventilated.

Switchboard.

The switchboard was designed and manufactured by the General Electric Company, and is situated in a gallery running across one end of the engine room; the assistant engineer's room is very conveniently placed at the end of the gallery, upon which it opens. The design of the board is such as to combine simplicity with safety and accessibility, and these objects have been attained to a very high degree. Our illustration shows that the board consists of panels, of which all the positives are grouped at one end and the negatives at the other, with the neutral and battery panels in the centre. Each of the 10 feeder panels bears voltmeter, ammeter, duplex fuse, main switch, and six-way pressure regulating switch. In addition to the ampere scale, each ammeter is provided with a volt scale showing the pressure to be applied at the station end of the feeder when the corresponding current is flowing through it, in order that the pressure at the feeding points may be maintained at its normal value; by this means the use of pilot wires is rendered unnecessary. As only one positive and one negative bus bar is used, the pressure between this and the middle wire must needs be that required by the feeder having the greatest drop at any moment; the pressure on the other feeders is, therefore, to be reduced by means of "back E.M.F." cells.

Each dynamo panel, of which there are four pairs, carries a main switch and duplex fuse; in addition, the positive panel carries an ammeter, a minimum current cut-out, and a shunt regulator, while on the negative is a watt-hour meter of the Aron type.

The centre panels carry the 15-point switches for controlling the battery charge and discharge, throw-over switches, the switches and instruments connected with the balancer, and the middle wire connections and meters.

On the back of the board are mounted two main circuit Aron meters; the pressure wires for these are brought back from the distributing mains, so that they record the energy actually supplied to the consumers. As the meters on the dynamo panels record the total amount of electrical energy generated, the difference between the two records gives directly the distribution losses; the main circuit meters also act as checks on the consumers' meters.

The watt-hour meter in circuit with the balancer is also fixed behind the board.

The bus bars are supported on cast-iron brackets, with slate insulators, at the back of the switchboard; all the conductors are painted red, black or blue, according to their polarities, and the connections are exceedingly clear and easy to follow, besides being perfectly accessible. The board is surrounded by a cast-iron moulding, no wood being used in the construction.

Two recording voltmeters are fixed in the assistant engineer's room; these are connected with the bus bars, and therefore record the maximum pressure applied to the feeders at any instant. With the exception of these, all the ammeters

NIAGARA-BUFFALO.—FIG. 1.

and voltmeters connected with the switchboard are of the moving coil type, with permanent magnets. All the instruments, except the Aron meters, were manufactured by Messrs. Nalder Bros. & Thompson.

TEST ROOM.

The test room is situated on the ground floor, at some distance from the engine room, and is equipped with a complete set of instruments for testing meters, &c., including two Kelvin balances, with a range from 1 to 400 amperes, and a 500-volt multi-cellular voltmeter. A reflecting galvanometer, with a figure of merit of 21,600 megohms, is mounted on a polished granite pillar in the centre of the room, the pillar being carried down to the foundations of the building; the transparent galvanometer scale is fixed on the testing table directly in front of the operator.

MAINS.

The feeders are drawn into Doulton conduits, of which about 50,000 feet of ducts have been laid under the footways. The conduits are three, two and one way, the ducts being either 4 inches or 3 inches square. The cross section of the "outer" conductors is 0·3 square inch, and of the "middle" conductor 0·125 square inch; the latter is the outermost conductor in the concentric cables, and is earthed at the station.

The distributors have a cross section of 0·1, 0·1 and 0·06 square inch, and are laid in wooden V-troughs, run in with a compound of tar and sand. All the cables, both feeders and distributors, are insulated with paper and lead covered; they were manufactured by the British Insulated Wire Company, Limited. Disconnecting joint boxes are fixed on all the cables at intervals of 440 yards.

PUBLIC LIGHTING.

The public lighting has been carried out with 90 12½-ampere arc lamps, arranged nine in series across the "outers," between which a pressure of 440 volts is maintained; the lamps were made by Messrs. Johnson & Phillips. In addition to the arc lamps, each lamp-post carries two incandescent lamps, and an Edmunds change-over switch; the arc circuits are controlled in pairs from five switch pillars. The arcs are extinguished at midnight, their place being taken by the incandescent lamps, which are fed from the 220-volt mains.

PRIVATE SUPPLY.

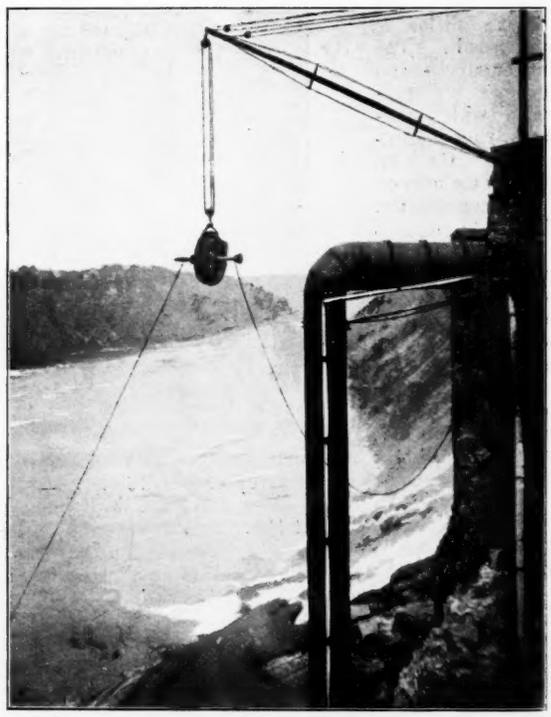
The Vestry has decided to adopt the maximum demand system of charging for private lighting at the rate of 6d. per unit for the first hour, 4d. for the second, and 3d. for the third. For power, a uniform rate of 2½d. per unit is charged.

We may add that the resident engineer is Mr. J. R. Blaikie, assisted by Mr. F. M. Rogers. We are indebted to these gentlemen, to Messrs. Kincaid, Waller & Manville, to the Vestry Clerk, and to the contractors, for their kind assistance in preparing this account of the works.

BUFFALO AND NIAGARA FALLS.

THE Buffalo and Niagara Falls Electric Light and Power Company, of Niagara Falls, has just installed a new dynamo made by the Walker Company, of Cleveland, O. This machine is an alternating current dynamo of 700 kw. capacity at 2,200 volts pressure, and will be operated at 250 r.p.m. and 125 cycles per second. The lowering of the field of this machine over the Niagara cliff proved quite a task. Its weight was over 17 tons. It was moved from the cars to a point near the edge of the bank on rollers, and then the boom of a derrick was made fast to it preparatory to letting it over the cliff to the power house 200 feet below. In raising it from the ground, it was necessary to lift it high enough to clear the roof of one of the cliff paper mill buildings, and then the boom was swung around to the position shown in fig. 1. At this point it was discovered that the boom could not be swung any further, owing to the fact that the bed had broken. Under these circumstances the field had to be swung back to the cliff and lowered to the ground, where it rested until the derrick was repaired. This occupied a couple of days, after which a successful effort was made and the field lowered, as shown in fig. 2. It may be imagined that the safe arrival of the field in the power station ended many fears.

In fig. 2 may be seen an interesting feature of the Niagara development. This is the light line running up along the



NIAGARA-BUFFALO.—FIG. 2.

big penstock visible in the picture, which is an aluminium bar conductor running from the power house to an alloy works on the high bank. At the top of the cliff the aluminium bar is connected to three copper cables, each of 500 c.m. In size, the aluminium bar is ½ inch × 7 inches. The current it carries comes from a 235-H.P. generator.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page* 1024.)

Dundee.—Mr. Manville's report, mentioned in our last issue, has been adopted by the Tramways Committee, which advises almost unanimously the use of the overhead trolley system. The committee further resolved to start the work of reconstructing the Perth Road and Lochee routes, with a view to the lines being worked by electricity. There has been a great increase in the traffic since the lines were taken over by the Corporation. It was resolved to apply for a provisional order for a new route to the north of the town.

Glasgow.—At a meeting of the Tramways Committee last week Mr. John Young, general manager, submitted a report and financial statement for the year ending May 31st. The gross revenue of horse and electric tramways for the year amounted to £439,000, and working expenses amounted to £318,000, leaving a gross balance of £121,000.

Greenock and Port Glasgow.—The Committee of the House of Commons on Monday last commenced the consideration of the Greenock and Port Glasgow Tramways Bill, which has for its object the use of electrical power on the tramways in Greenock, Port Glasgow and Gourock. Mr. Balfour Browne, Q.C., Mr. Coward and Mr. Moon represented the promoters, Mr. J. D. Fitzgerald, Q.C., and Mr. Ackworth appeared for the Greenock Board of Police, and Mr. Forbes Lankester represented the National Telephone Company and several owners who were opposed to the Bill.

Mr. Balfour Browne, in opening the case, said that the promoters sought to obtain power to use electrical energy on the tramways in Greenock, Port Glasgow and Gourock, and with that view to lengthen the life of the company at present working the lines. In all, the lines were a little over seven miles in length, and they ran continuously through Port Glasgow, Greenock and Gourock. It was admitted that they were in a bad condition, and that a considerable sum of money would be required to be spent to put them in a state for electric traction. They had three local authorities to deal with. In the case of Gourock the lines were owned by the local authority and leased to the promoters of the Bill for a period of 29 or 30 years by agreement. There were two conditions with regard to lines in Greenock. In the first place, there were lines which belonged to the Corporation which were leased to the company for a term of years expiring in May, 1900, at an annual rent of £700. From Rue End Street to the boundary of the burgh, going eastward, the line belonged to the company. It was owned by them under the Tramways Act, and the Greenock Corporation had the right to step in and purchase after November, 1899. In Port Glasgow the lines were also the property of the company, but the local authority there had not the right to purchase until 1908. But Port Glasgow and Gourock had both seen the importance of having the system worked as one line, and the former Corporation had agreed to extend the period of purchase beyond 1908, giving the company altogether a term of 36 years, and in Gourock they were lessees for 30 years. The Greenock Corporation, who were represented by the Board of Police, opposed the Bill, but for what reason he was at a loss to understand. All the powers in the Bill referring to Greenock were permissive, and subject to the consent of the Corporation. The company could not do any single thing without first obtaining the consent of the Corporation, who were really the masters of the situation. It would appear, however, that the members of the Corporation were very much divided in opinion on the matter. If they wanted the lines worked by electricity they would consent, but without that consent the company would not be able to proceed. He was advised that the voting by the Corporation to oppose the Bill was 11 to 10, and in all the circumstances of the case he hardly thought they were justified in spending the money of the ratepayers, seeing that the Bill did not interfere with any of the existing rights of the Corporation.

Mr. Walker, the secretary to the Tramways Company at Greenock, gave evidence in support of the Bill. In reply to Mr. Coward, he said he was strongly of opinion that a cheap and expeditious service of electrically equipped cars would be of great advantage to the community generally, and particularly to the working classes. On their present system the company carried nearly 2¼ millions of passengers every year, and he would expect to see those numbers largely increased if the lines were worked by electricity.

In cross-examination, the Witness said that the Tramways Company were the promoters of the Bill, and were paying the expenses of the promotion. The gentleman whose name was on the back of the Bill was the solicitor to the British Electric Traction Company. He admitted that in June last his company entered into an agreement with the Electric Traction Company, in which, among other things, that company undertook to assist his company in getting legislative authority for working the tramways by electricity, and his company on their part undertook to use their best endeavours to obtain extension of the leases. The agreement also provided that for the purpose of any negotiations or applications the British Electric Traction Company should be at liberty to use the name of the Tramways Company.

The fact is, that the British Electric Traction Company are to pay all the expenses of the promotion of this Bill?—That is so—they are shareholders.

The Committee then adjourned.

The Committee resumed its sitting on Tuesday, Mr. A. de Tatton Egerton again presiding.

Mr. Walker, the secretary to the Tramways Company, under cross-examination, said he supposed it would be necessary to have a separate generating station for each tramway. If the Corporation got the whole of the trams into their hands, they would be able to work them by electricity.—Bailie Clink gave evidence in favour of the Bill, and said he thought it was of importance to the town that the tramways there should be electrically equipped. He thought it was essential that the Greenock tramways should be worked in conjunction with those in Gourock and Port Glasgow. The witness was also examined as to the meeting at which the resolution to oppose the Bill was passed by a majority of one, and he said that had he been present he would have voted against such a resolution. He believed other members of the Corporation who were absent would have done the same.—Ex-Provost Steel also gave evidence in support of the Bill, as did Provost Stewart, of Gourock, and Mr. James Glen, clerk to the Gourock Commissioners—the latter laying particular stress upon the advantages which would accrue from having all the lines under one authority.

After further evidence had been called, the Committee again adjourned.

Isle of Man.—On Saturday the electric railway between Douglas and Ramsey was opened for traffic over the full distance. The line was opened last year, but only between Douglas and Ballure. During the winter Ballure Glen has been crossed by a fine bridge, and the cars can now run into Ramsey. The double line, too, has been completed throughout. The distance is 17 miles, and the through cars accomplish the journey under 50 minutes.

Kingswinford.—The British Electric Traction Company have now made a beginning with the Wordsley section of their Kingswinford tramline, whilst the Kinver line is being vigorously pushed on. Nothing, however, is as yet being done with regard to the tramway extension through Stourbridge.

Leeds.—A trial trip was made last Saturday on the Headingley electric route.

Oldham-Middleton.—There is now every prospect that the British Electric Traction Company will go forward with this tramway project. They have intimated to the Middleton Corporation their intention of commencing operations.

Peterborough.—Mr. E. A. Paris, the district superintendent of the British Electric Traction Company, appeared before the Council last week with reference to the proposed electric tram scheme, asking that body to assent to the preamble of the Bill. The Council has, however, adopted the report of the Main Roads and Bridges Committee, who decided not to make any recommendation regarding the scheme, as they had no details before them to enable them to form an opinion.

Pontypridd.—Last week the District Council resolved to oppose the light railway scheme promoted by the British Electric Traction Company.

Sedgley.—The British Electric Traction Company have decided to lay down an electric plant for the Sedgley and Wolverhampton route as soon as the royal assent has been given to the provisional order already granted by the Board of Trade.

Swinton.—The Swinton and Pendlebury Electricity Committee has reported that a letter had been received from the Local Government Board, approving of the resolution of the Council to oppose in Parliament the Manchester Corporation Tramways Bill and the Salford Corporation Tramways Bill.

Tunstall.—The District Council last week had before it a letter received from the Potteries Electric Traction Company, stating that owing to the car builders being behind time the company had not at present sufficient rolling stock to work the Trubshaw Cross route, and if the Council insisted upon this route being worked if the line from Burslem to Tunstall was worked the company could not give the undertaking required. They, therefore, asked the Council to modify their requirements. The clerk was instructed to ascertain when the company would be in a position to commence running in the Tunstall district.

Southport and Lytham.—The House of Lords Committee under Lord Herries continued the hearing of this Tramway Bill on Wednesday last week. Sir G. Pilkington, M.P., called for the promoters, said the means of communication between Southport and Birkdale and the places on the northern shore of the estuary were very unsatisfactory. He was of opinion that the proposed tramway would be largely used, and be of great benefit to the district generally. The tramway would also facilitate business communication between the towns, and confer distinct benefit on the rich agricultural districts behind them. The feeling of Southport was strongly in favour of the scheme. He had no doubt the proposed capital would be raised. Mr. Pember drew attention to the strongly worded report of the Board of Trade, in which they said that since the issue of the report of the commission the Board had always declined to give their consent to any works or operations which might lead to accretion and thus diminish the total capacity of the estuary, and they viewed with apprehension the results that might follow the construction of the proposed tramway across the sands on the southern side. The proposed conveyor bridge across the navigable channel would, according to the deposited plans, have a headway of only 103 feet above high water, and the Board were advised that this height was insufficient to the navigation of vessels to and from the docks. The Board were also advised that the existing facilities at Lytham for boats engaged in the fishing industry would be seriously affected by the tramway on the Lytham side, and that the possibility of the

works being commenced and not completed but left derelict should receive careful consideration.—Sir G. Pilkington said he had not seen this report. He stated he was advised there was no ship that could not pass under the bridge by lowering its topgallant mast, and there was nothing in the scheme calculated to cause accretion.—Alderman Griffiths and the Mayor of Southport (Mr. Austin) testified to the feeling in Southport in favour of the scheme, and several witnesses from Blackpool and Lytham also gave evidence in its support.—Mr. C. Chambers, member of a firm of iron merchants in London, spoke from experience of the successful working of the conveyor bridge at Bilbao. In answer to Mr. Mellor, he said the bridge was about 150 feet above high water.—Mr. J. T. Wood, civil engineer, Liverpool, one of the engineers for the proposed works, gave details of the proposed tramway.—The Committee again adjourned.

At Thursday's sitting of the Committee considering the Bill, Mr. R. J. Moore, joint engineer for the scheme, gave evidence, and said that the works would not diminish the tidal capacity of the estuary. If the Committee so desired, the bridge over the trained channel would be raised to a height of 150 feet above the wave level. This would cost an additional £12,000. In cross-examination he said that in designing the bridge the maximum pressure of the wind had been allowed for. He was aware that the wind and waves at Blackpool were advertised as being at times of unusual force, but he considered the wind and waves at Brighton, where a similar tramway was in operation, were equal to those in the estuary of the Ribble, where the force of the waves was broken by the sands.

Mr. G. F. Deacon, civil engineer, said that he would have refused to have anything to say for a scheme for carrying the tramway on an embankment over the sands. Now that the metals were to be laid level with the sands, he was of opinion that the tramway would not interfere with the tidal capacity of the estuary, and the scheme was perfectly feasible.

Capt. S. Nowell, consulting naval expert and marine surveyor of Liverpool, who had considered the proposed bridge from the point of view of its being an obstruction to navigation, said that many steamers using the port could pass under the bridge at the height proposed. He had taken measurements of considerably the largest sailing vessel that had gone to the port during the last 15 months, and he found that by striking her topgallant mast, which was a simple operation, she would pass under the bridge with something to spare.

This concluded the case for the promoters.

Mr. A. F. Fowler, resident engineer in charge of the Ribble Navigation Works, was called on behalf of the Preston Corporation. The effect of the proposed tramway and bridge would, he said, in his opinion, in view of the necessity of preventing accretion, be greatly prejudicial to the estuary, if not disastrous. The Corporation had expended close on £1,200,000 upon the improvement of the navigation, and the docks were capable of accommodating shipping of the largest class. There had been a gradual increase of the tonnage, which last year amounted to 374,809 tons, being larger than that of Fleetwood. The great bulk of the trade to Preston was by sailing vessels. If the bridge were to be erected at all, he would not be satisfied with less than a height of 200 feet above the wave level. There were many vessels at the present time that had masts as high as 187 feet.

The Committee again adjourned.

The Committee concluded the hearing of the Bill on Friday, when Mr. Pember, Q.C., representing the Preston Corporation, suggested that their lordships should invite the opinion of some representatives of the Board of Trade on the scheme. The committee acquiescing, Captain Vereker, R.N., of the Fisheries and Harbour Department of the Board, was called, and stated that in the course of his official duty he had visited the estuary and was acquainted with its conditions. The Board of Trade were of opinion that this scheme ought to receive very serious consideration before Parliament sanctioned it. The report of the Board was made on the assumption that the tramway from the south shore to the trained channel was to be laid upon an embankment across the sands. Now that they were informed the tramway was to be on a level with the sands, he did not view the works with the same apprehension, but he still feared they would have a tendency to cause accretion in the estuary.

Sir A. Rendel, C.E., was satisfied the promoters had not sufficiently taken into consideration the fact that the sands of the estuary were in an unstable condition, and in his opinion the tramway would cause accretion, whether on the level or not.

Two Trinity House pilots gave evidence to the effect that there would be considerable difficulty in getting vessels under the bridge at the height proposed, and the town clerk of Preston (Mr. Hamer) gave information as to the cost of the Ribble navigation and the trade of the port.

Mr. Pember, having addressed the Committee on behalf of the Preston Corporation, criticising the financial aspects of the scheme and the evidence which had been given, said the scheme was of an entirely novel character, and he had doubts whether any large number of persons would desire to be conveyed in cars pendulum-wise over this windy estuary with a chance possibility of being made seasick by the way. From the point of view of the Preston Corporation the scheme assumed really serious importance. On the one hand, the Committee had to consider the convenience and pleasure of excursionists, and on the other, the interests of a port with great possibilities before it.

The Committee, after a short consultation, decided to reject the scheme except as regarded tramway No. 1, which was a short line from Southport to the edge of the estuary, and as to which there was no opposition.

The Niagara Gorge Electric Railroad.—The Niagara Falls and Lewiston Electric Railroad Company, which company built, and for four years operated, the electric railroad through the Niagara gorge along the New York State bank, will pass out of existence, and be succeeded in business by the Niagara Gorge Railroad Company. This change is the result of a sale of the road by the sheriff of the Niagara county in Lockport on May 23rd. The purchaser was Herbert P. Bissell, of Buffalo, who is the chief promoter of the new company, and who is the only one of the old company remaining in the new company. The capital of the new company will be $1,000,000, whereas the old company was capitalised at $1,400,000. During the month of May large gangs of men were employed in the reconstruction of the roadbed, removing fallen rock, and putting in new trestles and bridges. New retaining walls were built at several places. The roadbed was reballasted and the overhead construction repaired. It is stated that steel bridges will replace all wooden structures. Governor Roosevelt, of New York, has signed the Bill which will allow the Commissioners of the New York State Reservation at Niagara to construct, without expense to the State, street railroad tracks upon and along that part of the Riverway, so called, between Falls and Niagara Streets in the city of Niagara Falls. The Commissioners, in their discretion, may grant revocable licenses to street surface railroad companies to use such tracks upon such terms as the Commissioners may prescribe. The Riverway is the street running along Prospect Park, and the new law makes it possible for the International Traction Company to make connection between their Falls Street tracks and the trolley car tracks of the Niagara Falls Park and River Railway on the upper steel arch bridge. The construction of this loop will thus make connection between the tracks used by the Buffalo and Niagara Falls cars and the tracks that run along the Canadian bank of the river to Queenston. Thus, in the future, electric cars may be run from Buffalo, N.Y., to Queenston, Ont., the steamer landing direct.

TELEGRAPH AND TELEPHONE NOTES.

German Trans-Atlantic Cable.—We understand that the ss. *Britannia*, belonging to the Telegraph Construction and Maintenance Company, has completed the survey between the Azores and the United States, and has now left New York. It appears that the German Government is desirous of having a means of communication with the United States independent of England or France, and proposes to lay a cable direct from Germany (Emden) to the Azores, and from thence to America. In this case the Emden-Vigo-Lisbon-Azores cables will not form part of the direct system, although we understood that they are laid with that object, and it may be possible that the proprietors of these cables, should no equitable arrangement become to, will have grounds for complaint against the German Government. The laying of the Lisbon-Azores cable was not without benefit to some of the joint proprietary companies, as by this means the various concessions and privileges granted by the Portuguese Government were amplified and extended in time. However, a direct cable to the Azores will serve the purpose of duplicating the existing line, a very necessary proceeding in this case, as the Emden-Vigo cable has been interrupted at least six times since it was laid in 1896. On this latter ground alone it is conceivable that the German Government should object to the existing line forming part of their communication with the United States.

The Pacific Cable.—The present position of this affair is very ably dealt with in the *Times* of last Monday. The writer shows that Mr. Chamberlain has every wish to meet the views of the Colonies on the points on which such strong feeling was aroused in Australia and Canada by the recently-announced decision of H.M. Government to depart from the recommendations made in the Report of the Pacific Cable Committee, on which basis the Colonial Governments had come to a common agreement, fully anticipating that H.M. Government proposed to deal with the matter on the same lines. The principal point objected to in the offer recently made by Mr. Chamberlain was that the English Government did not propose to share in the guarantee, while claiming an undue share of control in the common property of the Governments concerned. We are now glad to see that on reconsideration the aspirations of the Colonies will be met, at least in part. The writer in the *Times* points out the danger of delay in carrying this scheme into effect. The danger which would be entailed by delay is clearly set forth in a letter written by Sir Sandford Fleming, and which appears in a recent issue of a Canadian Blue Book. Speaking of the Eastern Extension Telegraph Company, Sir Sandford Fleming says:—"Fearing competition and a reduction in the high charge exacted, its attitude has always been hostile to the Pacific cable. On every occasion during the past 12 years it has thrown obstacles in the way of connecting Canada and Australasia telegraphically, and has frequently employed subtle means to accomplish its ends. One such attempt was exposed at the last meeting of the Canadian Senate (April 28th) when the Secretary of State and the leader of the opposition were of one mind in denouncing it. On that occasion the Minister of Justice used these words:—'I apprehend that for 100 years there has been nothing more seriously done under Imperial authority affecting Colonial interests than the attempt to create a monopoly and restrain and cripple the commercial growth of this country.' The case alluded to is but a single illustration of the means taken by that company to defeat the aspirations of Canada and Australasia. When the history of the conflict between these countries and the monopoly comes to be written, it will be found that the case recently unveiled does not stand alone, that there are a number of other cases equally extraordinary. The monopoly's present design is to delay the British Pacific cable until their own adverse scheme be sufficiently advanced. There is evidence to show that the Eastern Extension Company is in alliance with a company organised in the United States to lay a cable from San Francisco to

Manila. This company did not succeed before Congress rose in getting the subsidy it sought, but it succeeded in defeating the Government measure to establish a cable to Manila under the United States Post Office Department. Having done so, there is a strong probability that it will obtain all it wants when Congress again meets. With a cable stretched from San Francisco to Manila and there connected with the Eastern Extension cables, the two companies will practically become one concern. If, before then, the British Pacific cable has made no progress, there will be small hope for it afterwards."

In the House of Commons on Tuesday Mr. Hogan asked the Secretary of State for the Colonies whether he was now in a position to announce a mutually satisfactory agreement between Her Majesty's Government and the Governments of Canada and Australasia in reference to the construction of the Pacific cable. Mr. Chamberlain replied that the matter is still under discussion.

We understand that at the Colonial Office conference to be held shortly on the Pacific cable question, New South Wales will be represented by the new Agent-General in London, Sir Julian E. Solomons, Q.C., and General Sir Andrew Clarke, the Agent-General for Victoria. The Hon. Sir Horace Tozer will act for Queensland, and the interests of New Zealand will be represented by the Hon. W. P. Reeves. As regards Canada, Lord Strathcona and the Hon. Mr. J. G. Tarte, Minister of Public Works. Sir Sanford Fleming will act as advisatory expert.

The Reduction of Telegraph Rates to India.—Mr. John Galloway, chairman of the Glasgow Chamber of Commerce, in referring to a communication which had been received from the Bengal Chamber of Commerce on the subject of telegraph rates to India, stated that he had waited upon Mr. Pender, the managing director of the Eastern Telegraph Company, in London. Mr. Pender entered fully into the question with him, and explained that the company could not, in present circumstances, entertain the request of the Bengal Chamber of Commerce. The Bengal Chamber asked that the rate should be reduced from 4s. to 2s. a word. Mr. Pender pointed out that if the company were to recoup themselves by greater traffic, they would require to have the traffic doubled, and their present cable could not then carry it. The cost of an additional cable was from £1,500,000 to £2,000,000. It was true that the rate to Australia was less than to India, but the company were enabled to do this by the subsidy they received from the Australian Government. The company were willing to enter into negotiations with the Indian Government with a view of meeting the loss in the case of a reduction of rate. We are afraid that as far as regards the increase of message-carrying capacity, the Indo-European landline seems to have been overlooked here as a useful factor in this calculation, and yet we have been told that on occasion *all* the traffic from the Far East, Australia, and India has been carried over the Indo-European line. In fairness we must admit that this happened some time ago, and before the volume of Australian messages had, thanks to decreased rates, become so large as it is at present. Still, we are inclined to believe that had Mr. Pender taken the Indo-European lines into consideration, his reply would have been much more hopeful in tone. It may possibly, for safety, be necessary to provide a new cable; but it would be very much less costly, for the purposes of general traffic, to put another wire or two up on the posts of the Indo-European landline. Besides this, much good might be effected were the Eastern Telegraph Company to use their influence at Constantinople to urge on the Turkish Government the great advantages to be derived from keeping the Turkish landline from Constantinople to the Persian Gulf in good working order. The rate from London to Constantinople is only 6½d. per word, and from Constantinople to Fao, on the Persian Gulf, where the Indian Government cable is joined, is only about the same length as the line from London to Constantinople. With both these landline systems working at a rate of, say, 10½d. per word from London to the point where they join the Indian Government system, we could afford to regard the submarine cables principally in the light of their strategic utility, although it is true that even from this point of view their value is questionable. As regards the comparison of the 4s. 9d. rate to Australia with the 4s. rate to India, in their relation to the Australian Government, the statement made does not seem quite clear at first sight. We have often been told that the subsidy referred to, viz., £32,400 per annum (which expires next month) which has been paid to the company since 1879, was given, not in aid of impoverished revenue, nor as a grant for general purposes, but as Government assistance towards the establishment of the second cable to Australia, which was laid in 1880, and which it was necessary to lay, owing to the frequent failures of the "pioneer" cable laid in 1871. We are glad now to find authority for regarding this subsidy in a broader way, as being, in fact, of general assistance to the finances of the company, instead of being considered a matter appertaining solely and only to the particular account of the No. 2 Port Darwin cable. That this subsidy, apart from establishing a precedent, can be looked on as having any considerable relation to the rates to Australia, is very doubtful. The revenue of the Eastern Extension Company for the year ending December, 1879, was £316,037, while for the year ending December, 1898, it was £567,714, an increase of £250,000, due, to a great extent, to the reduction of rates. The working expenses cannot have increased to any great extent, and the cables have been repaired and duplicated out of the earnings, which have also furnished this company with a reserve fund of about £825,000. It is therefore evident that the subsidy plays but a very minor part in the receipts of the company, and that without it they have an ample margin of profit within which to deal with Australian traffic. As regards the Eastern Telegraph Company, which owns the cables from India to England, the revenue for the year ending September, 1879, was £464,173, while for the year ending September, 1898, it was £937,399; an increase of £473,000. The Indo-European Telegraph Company, the Landline Company, which works in joint-purse agreement with the Eastern Telegraph Company, had a revenue of £86,358 for the year 1879, and £134,642 for 1898; an increase of £48,284. With these figures before us, it appears regrettable that the interests of the Indian telegraphing public should have received such scanty consideration during the last 20 years from the companies concerned. As to the suggestion that the Eastern Telegraph Company is willing to enter into negotiations with the India Government concerning a possible loss due to a reduction of rates; the Indian Government should not lose sight of the fact that any reduction is quite as beneficial to the English telegraphing public as it is to those in India, and that, therefore, any guarantee against such loss should be shared equally between the Home Government and the Government of India. We read the following in the *St. James's Gazette*:—

> The agitation in India for a reduction in the cable rates with Europe is still proceeding, the latest important body to keep alive the agitation being the Cawnpore Chamber of Commerce. This Chamber has memorialised the Government of India and particularly favours an all-British cable. It is asked that the rate shall be fixed at 1s. per word, at which figure it would greatly facilitate trade, while at the same time it would be of great convenience to the public generally. The reduced cost would bring a greater flow of messages, and conduce in the long run to more profitable working. The Cawnpore Chamber advocates a new and independent British line. The cost of telegraphing from England to India has become, it is asserted, a serious matter in the cotton trade, as the charges in the year's aggregate amount to a very considerable sum in the accounts of each individual company.

Natal Telegraphs.—The Natal Government are, according to advices by a recent mail, about to bring in a Bill giving them a monopoly of the telegraph and telephone services of the Colony.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Bonny-Cameroun	May 29th, 1899 ...	...
Latakia-Cyprus	June 21st, 1899 ...	...
Para-Maranham	April 10th, 1899 ...	...
Amazon Company's cable— Cable beyond Gurupa ..	June 11th, 1898 ...	...
Landlines.		
Communication between Saloniks and Monastir .	March 16th, 1899 ...	...
Port au Prince-Jeremie ...	June 14th, 1899 ...	...
Majunga-Tananarive ...	June 17th, 1899 ...	June 18th, 1899

The Telephone Bill and Municipal Trading.—On Monday night, says the *Times*, a resolution was adopted by a meeting of members opposed to the extension of municipal trading, held in one of the committee rooms of the House of Commons. This resolution, which was moved by Mr. Boulnois, seconded by Mr. Bonsor, and carried unanimously, placed on record an expression of opinion that, if the Telephone Bill be read a second time, it ought to be referred to a Select Committee. At the same meeting it was agreed, on the motion of Mr. Evelyn Hubbard, seconded by Mr. Cohen, that urgent representations should be made to the Government as to the desirability of appointing at once a committee to inquire into the question of municipal trading and of the limits which should be imposed upon it. Sir John Lubbock presided at the meeting, and amongst those present, in addition to the members named, were Mr. Howard, Mr. C. M'Arthur, Mr. Begg, Colonel Long, Mr. Brodie Hoare, Mr. R. G. Webster, Mr. J. W. Wilson, Mr. Bartley, Mr. Kimber, Mr. Seely, Mr. R. Cavendish, Mr. J. Bailey, Mr. H. Hobhouse, Sir E. Durning-Lawrence, Mr. Bond, Mr. Byrn Roberts, Mr. Moon, and Mr. Giles. After the meeting, Sir John Lubbock and others waited upon Mr. Hanbury, as a deputation, to make him acquainted with the purport of the resolution which had been passed with regard to the Telephone Bill. Mr. Hanbury's reply, however, was not of a nature calculated to give his interviewers much encouragement.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barrow-in-Furness.—June 28th. The Corporation wants tenders for an additional engine and generator, with extensions to the switchboard and connections. Specifications, &c., from Messrs. Kincaid, Waller and Manville, on payment of £3 3s.

Canary Islands.—July 16th. Tenders are being invited until July 16th by the Spanish Post and Telegraph Authorities in Madrid for the concession for the establishment and working of a telephone system between Haria and Arrecife with three intermediate stations on the island of Lanzaroto, Canaries. Tenders to be sent to La Direccion General de Correos y Telegrafos, 10, Calle de Carretas, Madrid, whence particulars may be obtained.

Germany.—July 4th. The State Small Arms Works authorities at Spandau are inviting tenders until July 4th for the supply of 1,200 incandescent lamps, and 13,000 sets of arc lamp carbons. Particulars may be obtained from, and tenders are to be sent to, Der Direktion der Gewehrfabrik, Spandau, near Berlin.

Glasgow.—July 22nd. The Corporation wants tenders for boilers, steam engines (main and auxiliary), three-phase generators, continuous current generators, rotary converters, boosters, and static transformers, surface condensers, feed pumps, circulating pumps, and air pumps, all for the electric traction scheme. See our "Official Notices" this week.

Glasgow.—July 22nd. The Corporation wants tenders for 80 electric tramcar bodies to sample and drawing. See "Official Notices" this week.

Hammersmith.—July 5th. The Vestry wants tenders for the supply of (*a*) transformers, (*b*) high and low tension sub-station switch gear; (*c*) transformer street boxes. Specifications, &c., obtainable at the Clerk's office, Town Hall, on deposit of £2 2s. Specifications can be seen at the office of the Electricity Department, 57, Fulham Palace Road. See our "Official Notices" this week.

Hull.—June 27th. The Kingston-upon-Hull School Board wants tenders for electric light wiring and fittings at the Central Higher Grade School (360 lights). See "Official Notices" June 16th.

Morecambe.—The Council wants tenders for an economiser for the electricity works. See "Official Notices" this week.

Nelson.—July 5th. Tenders are wanted by the Gas and Electricity Committee for the supply of an engine and dynamo (25 to 50 kw.), new or second-hand. See "Official Notices" this week.

Pembroke.—July 14th. The Electric Lighting Committee wants tenders for a jet condenser with air pump and cooling apparatus. See "Official Notices" June 16th.

Rathmines and Rathgar.—July 14th. The Electric Lighting Committee wants tenders for arc lighting equipment (108 series parallel lamps, posts and switch-gear, &c.), steam and other pipes, jet condenser and cooling apparatus. See "Official Notices" June 16th.

Salford.—June 30th. The Electric Light Committee wants tenders for the erection of offices and battery sub-station at the new electricity works in Strawberry Road.

Southampton.—June 26th. The Corporation is inviting tenders for the extension of the generating station at the Back-of-the-Walls, comprising accumulator and switch rooms.

Southampton.—The Council is wanting tenders for continuous current motor boosters, tramway switchboard, battery of accumulators, and accessories. See our "Official Notices" this week.

Spain.—June 25th. Tenders are being invited until June 25th by the municipal authorities of Alcala la Real (province of Jaen), for the concession for the electric lighting of the town during a period of three years. Particulars may be obtained from, and tenders to be sent to, El Secretario del Ayuntamiento de Alcala la Real (Jaen).

Wallasey.—July 20th. Tenders are wanted by the Council for alternating current transformers. See "Official Notices" this week.

Wallasey.—July 20th. The Council wants tenders for a 300 kw. alternator with engine combined. See "Official Notices" this week.

Warrington.—July 18th. The Corporation invites tenders for Babcock & Wilcox boilers, economisers, and pumps; high speed engines, direct coupled continuous current dynamos, balancers, and boosters; jet condensing plant, &c.; pipe work; 10-ton crane; switchboard, storage battery, mains, conduits, boxes; arc lamps and posts. See "Official Notices" this week.

West Africa.—July 10th. The Compagnie de Mozambique, of 45, Rue do Alecrim, Lisbon, is inviting tenders until July 10th for the concession for the establishment and working of a central electric power station at Beira for lighting and power purposes during a period of 25 years. Particulars from, and tenders to, above.

CLOSED.

Glasgow.—The electricity department of the Corporation has accepted offers by the Barrowfield Iron Works, Limited, for damper gear for the Pollokshaws Road and Port Dundas electric power stations; by Messrs. Crompton & Co., Limited, for carbons; by Messrs. W. T. Glover & Co., Limited, for rubber-covered and lead-covered cables and wires, two laid together and lead-covered, cables and wires (rubber-covered only), and rubber-covered and extra-taped cables and wires; by Messrs. Siemens Bros. & Co., Limited, for flexible India-rubber cables and wires only; by the Craigpark Company, Limited, for cables and wires (rubber-covered only) and cables and wires (rubber-covered and extra-taped)—all for Port Dundas electric power station.

London.—The Shoreditch Vestry on Tuesday considered the following quotations for the supply, laying and jointing of the cable required for the new arc extensions:—

W. T. Glover & Co.	1s. 10½d. per yard
British Insulated Wire Company	1s. 11d. "

In view of the prices being so close it was decided to divide the contract between the two firms, the length of cable required being about 12,000 yards.

Islington.—The Guardians have accepted the tender of Messrs. Frank Suter & Co., Limited, for an electric light installation for the Highgate Infirmary at £7,794.

London.—The following is a list of the tenders submitted for carrying out the electrical installation at Mr. Charles Wyndham's new theatre, to the specification of Messrs. Owen Lucas and Pyke:—

	£	s.	d.
W. H. Baughan & Co.	6,774	10	0
Laing, Wharton & Down	6,174	10	0
Chas. Peacock & Co.	4,680	10	0
George Stegman	3,750	0	0
Moody Bros.	3,675	17	0
Warburg, Dymond & Co.	3,409	10	0
Berry, Harrison & Co.	3,372	10	0
Hampton & Sons, Limited	3,311	10	0
Walsall Electrical Company	3,305	10	0
Foote & Milne	3,234	10	0
Brush Electrical Company (accepted*)	2,959	10	0
Roger Dawson	2,945	9	9
Strode & Co.	2,724	10	0
Alfred Slatter & Co.	2,674	10	0
Marryat & Place (per S. H. S. Austin)	2,393	10	0

* Subject to modification.

N.B.—All the above sums only include stage fittings.

NOTES.

Wireless Telegraphy.—Mr. Marconi is reported to have met with a carriage accident on Saturday evening on his way back to Wimereux, and he will be disabled for at least a week. We congratulate Mr. Marconi upon his escape, with slight personal injuries, from what might have been a very serious mishap.

It is stated that the Government of Trinidad has decided to adopt the Marconi system for communication with the dependency of Tobago.

The French naval authorities, acting in conjunction with Mr. Marconi, last Saturday conducted some successful experiments with wireless telegraphy between a ship and the shore in the English Channel. The French storeship *Vienne* was used for the purpose. Wimereux, near Boulogne, and the South Foreland lighthouse, on the Kentish coast, were used as the land stations. Messages were sent between the vessel and the English coast from off Boulogne, and afterwards at intervals, until the vessel was 12 or 14 miles away from that port. The greatest distance through which the messages were telegraphed was 42 miles, this being considerably in excess of the distance hitherto successfully covered. The increased distance appeared to have no effect, the messages being recorded at the receiving station at the South Foreland with unvarying distinctness. Messages were exchanged while the vessel was travelling at various conditions of speed, with the same result. An interesting feature in the experiments was stated to be the facility with which Mr. Marconi's latest development for cutting out a station was applied. The messages were sent at will either to Wimereux or to the South Foreland, without the other station being able to intercept them. The results of the experiments are to be reported to the French Government.

Gas for Motor Purposes.—Before the Incorporated Gas Institute annual general meeting at Westminster Town Hall on 15th inst., Mr. T. O. Paterson (Birkenhead) read a paper on "Gas for Motor Purposes." He pointed out that as gas manufacturers they were as directly interested in the supply of gas for motive power as they were in its use for illuminating purposes. They had, in addition to light, a great future before them in the supply of power to the electrician for producing electrical energy, not only for lighting, but, he believed, to a much greater degree for traction purposes.

The American Electro-Therapeutic Association.—This year's meeting of the American Electro-Therapeutic Association is to be held in Washington, on September 19th, 20th and 21st. The headquarters will be at Willard's Hotel, corner of Fourteenth Street and Pennsylvania Avenue, N.W. There will be an exhibition of electro-medical apparatus at Willard's Hall. Electric current, either direct or alternating, will be available. The charge for space will be 50c. per square foot. Dr. Clifton Mayfield is the chairman of the Committee on Exhibits.

Institution of Electrical Engineers' Conversazione.—For the third year in succession the Institution of Electrical Engineers held their annual conversazione in the Natural History Museum, South Kensington, on Thursday, 15th inst. The guests, to the number of over 1,400, were received by the President, Prof. Silvanus Thompson, and Mrs. Thompson, in the large central hall, which was decorated with palms and flowers. An excellent programme of music was performed by the string band of the Royal Engineers, conducted by Lieut. J. Sommer. Among those present were:—

Prof. W. G. Adams, F.R.S.
Prof. H. E. Armstrong, F.R.S.
Prof. W. E. Ayrton, F.R.S., Past President
Prof. Barker (of Philadelphia)
Sir J. Wolfe Barry, K.C.B.
Mr. W. W. Beaumont
Sir A. R. Binnie, L.C.C.
Dr. W. B. Bottomley
Mr. S. L. Brunton, Member of Council
Prof. H. L. Callendar
Prof. D. S. Capper
Col. J. J. Cardin, C.B.
Prof. Carus-Wilson
Prof. Chadwick
Prof. Ciamician
Prof. F. Clowes, F.R.S.
Sir J. Crichton-Browne
Mr. J. J. Courtenay
Dr. Crehore (U.S.A.)
Mr. R. E. Crompton, Past President
Sir William Crookes, F.R.S., Past President
Prof. E. M. Crookshank
Prof. Dalby
Herr M. von Dolivo-Dobrowolsky
Gen. Sir J. F. Donelly
Sir A. J. Durston
Mr. Henry Edmunds
Prof. D. C. L. Everett
Mr. W. P. J. Fawcus, Member of Council
Gen. Festing, C.B., F.R.S.
Mr. B. T. Finch, C.I.E.
Sir J. G. Fitch
Sir W. H. Flower, K.C.B.
Gen. Fraser, C.B., R.E.
Sir W. B. Gurdon, C.B., K.C.M.G.
Prof. W. D. Halliburton, F.R.S.
Mr. R. Hammond, Member of Council
Mr. H. E. Harrison
Sir G. W. Herbert, G.C.B.
Prof. D. E. Hughes, F.R.S., Past President
Sir R. Hunter
Prof. A. Jamieson
Lord Kelvin, G.C.V.O., F.R.S., Past President
Lieut.-Gen. J. W. Laurie
Mr. P. V. Luke, C.I.E., Member of Council
Sir W. MacCormack
Mr. W. G. McMillan, Secretary
The Rev. J. T. McGaw, D.D.
Sir Henry Mance, C.I.E., Past President
Mr. Hiram S. Maxim
Prof. R. Meldola
Prof. Michelson
Mr. H. W. Miller
Dr. Ludwig Mond
Mr. W. M. Mordey, Member of Council
Prof. Nasini
Major S. Flood Page
Dr. W. Pasteur
Col. Pennycuick, C.S.I.
Dr. W. H. Perkin, F.R.S.
Mr. J. R. Preece, C.M.G.
Prof. W. Ramsay, F.R.S.
Herr E. Rathenau
Sir J. Reckitt
Sir E. J. Reed, K.C.B.
Sir W. C. Roberts Austen, K.C.B.
The Rev. A. Robertson, D.D., King's College
Prof. H. Robinson
Sir B. Samuelson
Mr. R. P. Sellon, Member of Council
Prof. Short
Prof. W. J. R. Simpson
Mr. C. E. Spagnoletti, Member of Council
Prof. H. Spooner
Colonel Squier, U.S.A.
Dr. T. Stevenson, Pres. Inst. of Chemistry
Sir J. Swinburne, Bart.
Prof. W. A. Tilden
Capt. A. S. Thomson, R.N.R., C.B.
Dr. T. E. Thorpe, F.R.S.
Mr. E. O. Walker, C.I.E.
Mr. G. G. Ward, of New York
Prof. G. C. W. Warr
Sir S. H. Waterlow
Lieut.-Col. Watson, C.M.G., R.E.
Mr. Geo. Westinghouse
Sir W. H. White, K.C.B.
Herr K. Wilkens
Sir F. Wills
Capt. Eardley Wilmot
Gen. Sir C. M. Wilson, K.C.B.
Mr. E. Woods, Past President Inst. C.E.
Mr. Arthur Wright

Cricket.—We have received the match programme of the Shoreditch Electric Lighting Station Cricket Club for the 1899 season. Among the fixtures are contests with the St. Pancras Electricity Works Club, the St. James's and Pall Mall Electric Club, the Wandsworth Electric Club. Matches are played on the Shoreditch Club's private ground at Chingford on nearly every alternate Saturday at 8.15 p.m., and Hackney Downs is the place for practice. The president of the club is Mr. C. Newton Russell, engineer-in-chief at Shoreditch; Mr. C. F. Love is the secretary and treasurer, all communications for whom should be addressed to the Shoreditch electricity works. The editors of the electrical journals and five firms of electrical contractors are made honorary members. Mr. W. Weekes captains the club, with Mr. G. Kemp as vice.

Appointment.—Mr. F. G. Poulton, assistant engineer at the Winchester electricity supply works, has been appointed resident electrical engineer under the Hereford Corporation.

The Vibration Nuisance.—The following extract from Prof. John Perry's new work on the steam engine will be of interest to municipal electrical engineers:—

"There is a defect that is put up with in locomotives and in ships which is ever so much worse in a large town, and it has been declared to be a nuisance. Consequently, every young station engineer has already acquired an astonishing amount of cunning in diagnosing it and mitigating its effects. It is the vibration produced by reciprocating engines. Of course, the only real remedy is the use of a steam or gas turbine, sure to be applied in the long run; but capital has given momentum in the direction of reciprocating engine manufacture, and a complete change towards turbine manufacture must be slow.

Now, in the old days of slow moving engines, the vibrations due to masses moving with accelerations were not important. The vibratory forces are quadrupled when the speeds are doubled, and compact engines must run at high speeds; hence our troubles.

"We notice that rotating masses may be perfectly balanced quite easily. But it is a very different thing with reciprocating masses; to balance them needs careful study, and in many cases it seems almost impossible. I have stood on the frames, or rested my teeth against a pencil touching the frames of the best balanced engines now in the market, and could not detect any vibration; and yet when two, three, or more such engines are working in one station their slight effects coalesce, and there may be very considerable vibration of the ground. I have examined sets of flats in a large mansion near a central station, I have gone from room to room getting small indications of motion, and I have found that one room was in considerable vibration when its surrounding neighbours were quite quiet.

"The student of acoustics does not need to be told that this room was really accidentally tuned to the vibration, and just as one string of a pianoforte will respond to a suitable faint note, so this room responded to the faint impulses produced by distant engines.

"A householder lays his complaint; the flowers on his dining table are quivering always; the glass and metal ornaments are always rattling. The cunning young station engineer comes to inspect the quivering room; he says nothing at first; he goes about observing, touching, listening, and he finds some opportunity of slyly moving the heavy piano. No! he declares he feels no vibration. Curiously enough, the complainer also feels none, nor perhaps is he likely to do so until he moves that piano exactly into the same spot again. When vibratory impulses act upon a thing, we speak of its forced vibration, and also of the natural vibration which it has of its own. Its forced vibration will be small or great, depending upon whether the frequency of the forced vibration is far different from, or is nearly equal to, the natural frequency.

"Young engineers, spurred by necessity—the mother of all reform—know a great deal; they would know ever so much more if they studied acoustics a little, and more particularly if they studied the simpler parts of the mathematics of vibration. The engineer who is a good mathematician will study Lord Rayleigh's 'Theory of Sound.' I believe a study of my own books, 'The Calculus for Engineers,' and 'Applied Mechanics,' will give to the observant young engineer the sort of mathematical knowledge that he wants, and he will be fairly well fitted to fight the new nuisance if he adds a knowledge of some such book as Tyndall's 'Sound.'"

Appointments Vacant.—The Huddersfield Electricity Committee wants an electrician-in-charge for the electric supply station. See our "Official Notices" this week.

An assistant electrical engineer is wanted for working electric light plant at Lagos, at £300 per annum. See "Official Notices" this week.

Correction.—We regret that, in our description of the Watford Electricity Works last week, we inadvertently ascribed the Smith-Vaile feed pumps to Messrs. Blake and Knowles, Limited. As is well known, the Smith-Vaile pumps are supplied by Mr. Fred. Nell, of 97, Victoria Street, E.C.

The Telephone Bill.—The Telephone Bill introduced by Mr. Hanbury was submitted for a second reading on Tuesday evening, and on Wednesday Mr. Balfour said he gathered that there were strong and clearly expressed objections to much of the Government's plans, and he proposed to refer the Bill to a Grand Committee. Mr. Stuart heard the proposal with consternation, fearing it meant the killing of the Bill. Mr. Hanbury having expressed his firm belief that the course suggested by the leader of the House was the best way to endeavour to pass the Bill this session, it was read a second time, and Mr. Balfour moved that it be referred to the Grand Committee on Trade. Mr. Hanbury's speech for the second reading showed no readiness on his part to take a broader view of the question than on the introduction of the Bill. It is not surprising therefore that there should be a lack of confidence, if not direct opposition, from many members who, with a more neutral attitude on the part of Mr. Hanbury, might have been disposed to support the Government proposals. We do not know whether the House of Commons has a Grand Committee on Commerce. If so, it will be especially gratifying to Mr. Hanbury if the Bill should be referred to the Grand Committee on Trade.

The Nernst Lamp.—At the statutory meeting of the Nernst Electric Light Company, to which we refer at some length in our City pages, there were exhibited two indoor lamps having the following electrical constants:—60 C.P., 90 watts, ·45 ampere and 200 volts. The light was very charming, but it was open to question whether it was giving nearly four times the illuminating power of an ordinary 16-C.P. incandescent lamp in the same room. However, we do not at the moment intend to enter into any discussion on this point, but content ourselves for the time being by stating that the company seems to be in possession of a practical lamp, notwithstanding that the filament must still be first heated, which, however, is done electrically. The lamp works equally well with either continuous or alternating current. We cannot help thinking that the somewhat intemperate references to the technical Press made at the meeting were of the nature of things best left unsaid. No man has had greater support from those journals whose comments are now so unpalatable than the speaker himself, and although an editor may not know so much of the Nernst lamp as the man who is working it out to a practical issue, yet there are sources of information open to him of which he can make use. The shareholders seemed quite satisfied with the strictures passed on the technical Press; yet, if anything goes wrong with a company, these very men appeal to the Press to take up their cause. The technical Press is the natural guide and protector of those who choose to invest in electrical companies, and even its latest detractor would be the first to admit that but for its fearless and usually correct criticism the electrotechnical industry would not be in its present safe and sound condition. One thing further. When it is clearly proved that the technical Press is in error, it does not hesitate to frankly confess the mistake and make the *amende honorable*. It is scarcely fair to heckle the Press to-day for statements made on what was brought to its notice some time ago. Comments made upon an imperfect article which is to revolutionise the electrical world, are open to modification as improvement succeeds improvement.

Electrolytic Contact Breakers.—On the 10th inst. Mr. Apps contributed a short paper to the Röntgen Society on the Wehnelt and Caldwell contact breakers. Mr. Apps considered that in the case of the Wehnelt, the cause of the break was the formation of a layer of steam on the anode, the circuit being re-made by the condensation of this layer of steam. But it is difficult to imagine any action capable of bringing about this sudden condensation. Besides, a layer of steam is not a sufficiently good insulator to suddenly stop the current; it is certainly not so good an insulator as the layer of air in the ordinary break, and that is not sufficient to prevent a certain amount of sparking when the break is made. Walter's theory that this layer of steam when formed, is immediately electrolysed into a mixture of oxygen and hydrogen and exploded by the leakage spark, appears to be much more plausible. It is easy to understand on this theory, that anything which reduces the current will reduce the frequency of the break; inductance in the primary circuit is necessary to ignite the explosive mixture, and not to produce resonant electric oscillations, as has been frequently suggested. The Caldwell break (Electrical Review, Vol. 44, p. 874), which is considered by Mr. Apps to be deficient in durability, is probably explicable on the same theory as the Wehnelt. The whole current passing through the narrow column of liquid in a small orifice, generates a bubble of steam which is then electrolysed and exploded. Mr. Apps thinks the Caldwell break should be worked with a higher voltage than the Wehnelt, since, voltages being equal, the frequency of the former is less. It is premature, as yet, in Mr. Apps's opinion to discard the ordinary break in favour of the new forms.

Municipal Electrical Association.—The annual business meeting of this Association was held on Saturday morning at the conclusion of the Bristol Convention, Mr. Faraday Proctor presiding, and members only being present. The President opened the proceedings by expressing his very great regret at having been unable to be present at so large a portion of the discussions of the Convention, as his attendance had been necessary in London before a Parliamentary Committee in connection with the Bristol Corporation's opposition to the gas company's Bill. The treasurer's report and accounts and the secretary's report were received and passed. The financial position of the Association is satisfactory, and there is an increase in the list of memberships. The report of the sub-committee and the recommendations of the Council in reference to the Parliamentary Committee on dangerous trades were received and adopted. The report formulates amendments suggested by the Association in the proposed regulations for the greater security of employés, and these will be forwarded to the Home Office. The following gentlemen were appointed a sub-committee for the Association Benevolent Fund:—

> The Chairman of the Barrow Committee,
> Mr. Wordingham (Manchester) and
> Mr. Faraday Proctor (Bristol).

Mr. A. B. Mountain (Huddersfield), was elected president for the ensuing year, and it was determined that next year's Convention should be held at Huddersfield. Mr. A. S. Barnard (Hull), and Mr. J. E. Edgecombe (Kingston-on-Thames), were elected vice-presidents, and the following gentlemen were appointed to the Council:—Chairmen of Committees, Councillor Skinner (Hull), and Alderman Norman (Cheltenham), borough electrical engineers, Mr. W. A. Chamen (Glasgow), and Mr. A. Ellis (Bolton). A letter was read from the honorary treasurer, Mr. G. H. Cottam (Hampstead), resigning his office for the reason that he had not sufficient time to devote to it. The resignation being absolute was accepted, and Mr. J. H. Rider (Plymouth), was chosen as treasurer to succeed Mr. Cottam. The election of honorary auditor was referred to a committee consisting of the President and Mr. Rider. The remaining officers were re-elected. Votes of thanks were passed to the President, to the Lord Mayor and Corporation of Bristol for their reception of the Association, to the Museum Committee for the use of the lecture theatre, to the vice-president (Mr. Rider), who presided during the absence of Mr. Proctor, to the honorary secretary (Mr. Ruthven Murray), for the organisation of the Convention, to the retiring honorary treasurer (Mr. Cottam), to the honorary solicitor (Councillor G. Pearson, Bristol), and to the honorary auditor (Mr. W. A. Godfrey, Hampstead), for their services.

Lecture.—On 5th inst. Prof. Emerson Reynolds, F.R.S., delivered the concluding lecture of a special course on high temperature phenomena in the Chemical Theatre of the Dublin Trinity College. The lecturer referred to the available water-power in Ireland, also to the electrical work being done at the Falls of Foyers. As to whether peat could be used economically in generating electrical power, he said that if the factory were at the bog, and the peat were used in a rough and damp state, then it would be very economical as compared with coal, though not so cheap as water.

The Electric Lighting of the City.—The following letter appeared in Wednesday's *City Press*:—

Your correspondent, Mr. W. Fisher, hints that the Charing Cross Company is being made a "cat's paw" for the Corporation, to be used by that body in order to enable it in due course to enter into competition with the City of London Company. I have no doubt that this view is a correct one, and that it will take a practical form in the event of the Charing Cross Company making a financial success of its City undertaking; but there are very heavy odds against that event. If the Charing Cross Company fail, it is not likely that the Corporation will exercise its right to buy. If it succeed, the Corporation is not likely to lose the opportunity of taking over the concern. This is a miserable position for the Charing Cross Company to occupy, and is one the shareholders will want to know something about. It will be but poor consolation to know that the Corporation will have to pay a 10 per cent. profit on the cost if it take over the concern, for the shareholders are running the risk of a very heavy loss, one that may turn out to be the loss of the entire outlay. That the Corporation should lend itself to such an operation is but another step in the mire, another advance in its determination to take advantage of its own default. The contract with the City of London Company turns out to be bad in law, not on the part of the company, but on the part of the Corporation, and yet this body seeks to still further victimise the company by taking from them the right granted, and on the faith of which the company has spent hundreds of thousands of pounds. What would be thought of a private citizen conducting his business in that way! The streets are to be turned up, traffic impeded, and inconvenience and loss inflicted on innocent citizens (who have no remedy but to submit), and it will take a year or two to accomplish. Then what happens? The Charing Cross Company will offer for 5d. what the City of London Company offers to supply in January for 6d. But when the former company is ready, the latter will then come down to 5d. The effect of this would be to ruin the Charing Cross Company by rendering their outlay unproductive, for is it likely that City consumers will put up with all the nuisance involved in changing over to a new company when they will then be having the same thing at the same price from the old company? I earnestly hope that Parliament will put an end to this muddle by throwing out the Bill.—I am, &c., J. W. Martin.

Society of Arts Medals.—The Council of the Society of Arts have awarded the Society's silver medal to the following readers of papers during the session 1898-1899:—Prof. George Forbes, F.R.S., for his paper on "Long Distance Transmission of Electric Power"; Mr. Dixon H. Davies, "The Cost of Municipal Enterprise"; Mr. James Swinburne, "Nernst's Electric Lamp"; Mr. Philip Dawson, "Electric Traction"; Sir William Henry Preece, K.C.B., F.R.S., "Ætheric Telegraphy."

CITY NOTES.

Nernst Electric Light, Limited.

The statutory meeting of this company was held on Wednesday, Sir Henry C. Mance (chairman of the company), presiding.

The Chairman: Gentlemen, this is, as you know, our statutory meeting, which we are obliged to call in accordance with our articles of association. I have no resolution to put before the meeting to-day, and my duty is simply to tell you what we have done, what we are doing, and what we propose to do. We have been fortunate enough to secure the services of Dr. von Recklinghausen, who has worked for a considerable time with Prof. Nernst, and therefore we have the best and most competent man we could possibly find to assist us in the development of the lamp. We set carefully to work to make ourselves thoroughly familiar with the lamp by a long series of experiments, in order to test the life of the filaments and decide upon the most suitable sizes of the lamp for market purposes. When this company was first started it was believed that the chief use of the Nernst lamp would be for street lighting, but, as a result of our experiments during the last two or three months, we find that we can look forward to introducing the light for extensive use indoors. When we commenced operations it was expected that we should be chiefly competing for outdoor work, but I do not think there is a more elegant lamp than the Nernst on the market at the present time, and I have every confidence that it will be extensively used indoors. We have a lamp also which can be used for military purposes. The smallest lamp we have made is a 10 C.P. lamp and the consumption of current of the Nernst is just less than one-half the amount used by the present Ediswan lamps. We have been considering the desirability of acquiring some claim to the English rights—in fact, negotiations are being conducted with a view to obtaining an interest in the English market—and although matters have not yet advanced to a stage at which any definite announcement can be made to the shareholders, the directors have every hope that they will be able to conclude the negotiations in such a way that they will prove advantageous to the members of this company. We have taken care to protect our rights throughout our sphere of operations. I do not know that the time has arrived when I can make any declaration as to our future policy. We have sent out applications for information to all parts of the world, and we hope soon to receive replies which will guide us as to the class of lamp we must manufacture for the different countries. We have not yet decided as to whether we shall manufacture in this country or in Holland. A great deal will depend upon the attitude of the English company towards us, but I have no doubt we shall be able to make an arrangement which will be satisfactory to both parties. We have had offers made to us from manufacturers in Germany to supply the company with as many lamps as we require during the coming autumn, but it will be a question of cost. We are already making a few hundreds of lamps, and these you see in the room are some we have manufactured. We are making the lamps as perfect as possible in every detail, so that they cannot be improved upon.

Mr. B. M. Drake, M.I.E.E., managing director, said that when first he took over the management of the company he had to devote himself to the practical requirements of the invention and the securing of machinery suitable for manufacturing the lamps in large quantities. Up to that time the lamp had been more or less in an experimental stage, and nothing had been done in the way of obtaining machinery for preparing the lamps for the market. When he took office the lamp could only be automatically heated in 30 seconds, whereas at the present time it could be done in six seconds, which, of course, was a great improvement. As a practical engineer, he had no hesitation in saying that the Nernst lamp was good enough to cut out the ordinary carbon incandescent lamps. They now possessed a lamp able to work at 1½ watts per C.P., which would last 500 hours, and which could be automatically lighted in six seconds; in fact, it gave some light immediately. When Prof. Nernst was over in this country the other day, he informed the directors that he had been round to the several concessionaires, and he was quite satisfied that this company was well ahead of any of the other companies in the world. A conference was recently held in Berlin, at which the representatives of the concessionaires throughout the world attended, Mr. Swinburne and himself representing this company. After a long discussion, a protocol was arranged for the exchange of ideas and patents among the different holders all over the world. He need hardly point out to the meeting that this arrangement would enable them to get their invention into shape and quickly at work. They might depend upon it that they would make the most of the time during which the patents had to run.

The Chairman, in reply to a Shareholder, said that the cost of manufacturing the lamp would be about 1s., but what they would sell it at was another matter.

Mr. Cottam wished to know if the lamps were being sold in England at the present time.

The Chairman stated that the English patents were not in possession of the company as yet. They could use the lamps, he added, from 50 volts up to 500 volts, and from 50 C.P. to 500 C.P.

Mr. James Swinburne, M.I.C.E., consulting engineer, said he wished to make a few remarks relating to the press criticisms which were made when the company first came out. A statement which had been made referred to the patents being considered of little value by the Allgemeine Elektricitäts-Gesellschaft, because they had written them off at 1s. As a matter of fact, he believed the Allgemeine made a practice of writing off all patents, however great their value, at 1s., but in this particular case they could hardly have written off the Nernst patent, as they had not acquired it at the time. Whether that was so or not, the statement was absolutely misleading as a guide to the Allgemeine's valuation of the Nernst lamp. He considered that the technical criticisms had been made with very imperfect knowledge of the subject, and that technical papers should be just as careful in writing against a company as the advisers to the company should be in saying anything in its favour. He originally considered that the immediate future for the company, as far as profit-making was concerned, would be in selling large lamps to take the place of arc lamps, but since then so much progress had been made in the smaller lamps that he felt the latter was in a very much better position than it was originally. At the same time it must be remembered that the company had to deal with foreign countries where high pressures and large lights would probably be in very great demand, much more so than in this country. With regard to the opinion of Mr. Rathenau, he respected it as that of a very able commercial engineer; but it had to be borne in mind that the other holders of the Nernst patents were not in the same position as this company, inasmuch as they were also large makers of incandescent and arc lamps. They were, therefore, naturally more anxious to sell lamps that would take the place of the Welsbach street lamps, which were enormously used on the Continent, so that they would increase their output of electrical plant, instead of merely substituting one particular manufacture for another of their own manufacture. As regarded the policy of the company, he thought the shareholders ought to be patient. It might be possible to sell lamps this autumn, but he felt it would be much wiser to rely on the following autumn. The worst thing the company could do would be to send out lamps that were imperfect, or caused any sort of failure, and the next worst thing was to be overwhelmed with orders which they could not fill.

The Chairman, in answer to a shareholder, stated that a quotation had been applied for, but the Stock Exchange authorities wished for some slight alterations in the articles of association, and an extraordinary meeting of shareholders would be called to comply with that request. When that had been done they were informed that they would have no difficulty in securing a Stock Exchange quotation.

Mr. Swinburne remarked that, as regarded the patents, the general position was very good. As they would observe in the prospectus, Messrs. J. Fletcher Moulton, Q.C., M.P., and A. Colefax, stated, with reference to the patents, "the invention is, in our view, fundamentally different from anything that preceded it."

A vote of thanks to the chairman, on the motion of Mr. H. J. Barker, seconded by Mr. Howell, closed the proceedings.

British Columbia Electric Railway Company, Limited.

The third ordinary general meeting was held on June 19th at the Cannon Street Hotel, Mr. R M. Horne-Payne presiding. In moving the adoption of the report, the chairman stated that the buildings at New Westminster and Vancouver had been completed, and that the water-power installation at Victoria was now in full operation. Under the company's lease it had the right of using 4,000,000 gallons of water daily from the Goldstream Falls for a minimun rent; as this quantity of water is at present exceeded, a storage battery is to be put down to reduce the consumption and add to the capacity of the power station. The dividend recommended was 4 per cent. per annum, the amount to be distributed being £8,000, making, with the preference dividend, £15,500. The reserve fund would be increased to £12,000. The fares had been reduced by 20 per cent., but the earnings were well maintained. The lighting business was in a very satisfactory state; on March 31st last 32,640 lamps were in use, showing an increase since July 1st last of 4,650. The new machinery would be installed about September next, after which the business of the company could be increased, with, it was hoped, a considerable saving in expenses. The extension of the Sapperton branch would be taken in hand before long.

Mr. F. S. Barnard, resident director in British Columbia, seconded the motion, which was unanimously adopted.

Davis & Timmins, Limited.—Sir Henry Mance presided at the statutory meeting of this company at Winchester House on Tuesday. He said that the first five months of this year showed returns £1,000 higher than they were last year, which was, up to that time, the best they had had. They had obtained a site for a new factory at Wood Green. The equipment of that factory would comprise the newest and most up-to-date machinery. Since this company took over the concern on March 28th, very handsome profits had been earned.

At an extraordinary general meeting which followed, alterations in the articles of association were passed.

Prospectuses.—The prospectus of the West London and Provincial Electric Supply Company, Limited, issued on June 20th, reveals the fact that this company is practically identical with the Aberystwyth and Chiswick Electricity Supply Corporation, which was unsuccessfully offered for public subscription last year. The vendor proposes to sell 35,000 shares (£1 each, 15s. paid), in the latter concern to the new company for £20,000 cash and 15,000 fully paid shares. The list opened on June 19th and closed on June 21st.

The well-known company of Galloway's, Limited, is undergoing re-construction, the share capital being increased to £330,000 in £10 shares. The old company takes £50,000 debenture stock, £33,000 preference shares, £137,300 ordinary shares, and £167,000 in cash, in exchange for the business and assets. Messrs. E. N. Galloway and A. W. Galloway have been appointed managing directors, and Mr. C. J. Galloway has consented to act as chairman.

Eastern Extension, Australasia, and China Telegraph Company, Limited.—The directors have declared an interim dividend for the quarter ended March 31st of 2s. 6d. per share, free of tax.

Callender's Cable and Construction Company.—This company held its meeting for the adoption of report and accounts yesterday afternoon.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending June 17th, 1899, were £698 1s. 5d.; aggregate to date, £8,709 15s. 4d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending June 16th, 1899, were £3,165 14s. 7d.; corresponding period 1898, £2,835 12s. 4d.; increase, £330 2s. 3d.

The City and South London Railway Company.—The receipts for the week ending June 18th, 1899, were £899; week ending June 19th, 1898, £974; decrease, £75; total receipts for half-year, 1899, £26,017; corresponding period, 1898, £25,532; increase, £485. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending June 17th, 1899, were £189 12s. 1d.; week ending June 18th, 1898, £152 6s. 9d.; increase, £37 5s. 4d. Total receipts to date, 1899, £3,819 5s. 0d.; corresponding period, 1898, £2,986 8s. 5d.; increase, £832 16s. 7d. Miles of track open week ending June 17th, 1899, 8; week ending June 17th, 1898, 8. Car miles run week ending June 17th, 1899, 4,337; week ending June 17th, 1898, 3,890. Number of cars, week ending June 17th, 1899, 11; week ending June 17th, 1898, 7.

The Dublin United Tramways Company.—The receipts for the week ending Friday, June 16th, 1899, were as follows:—D. U. T. Co., horse cars, £2,283 4s. 9d.; ditto, electric cars, £1,888 0s. 0d.; D. S. D. Co., electric cars, £1 189 1s. 8d.; total, £4,810 6s. 5d.; corresponding week last year—D. U. T. Co., horse cars, £2 869 7s. 10d.; ditto, electric cars, £573 14s. 5d.; D. S. D. Co., electric cars, £741 1s. 7d.; total, £4,184 3s. 10d.; increase, £626 2s. 7d.; aggregate to date, £86,257 19s. 4d.; ditto last year, £80,762 8s. 7d.; increase to date, £5,495 10s. 9d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 11 miles electrically, and 31 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending June 18th, 1899, amounted to £1,496; corresponding week last year £1,440; increase, £56.

The South Staffordshire Tramways Company.—The receipts for week ending June 16th, 1899, were £640 16s. 11d.; aggregate receipts for 24 weeks, £15,169 13s. 1d.; week ending June 17th, 1898, £608 10s. 10d.; aggregate receipts for 24 weeks, £14,481 0s. 11d.

STOCKS AND SHARES.

Wednesday Evening.

Once more this week has the principal interest of the electric lighting market been centred round City of Londons. The shares early in the week developed marked flatness, falling to 14½, while at one time the dealers refused to make anything but 14½—14⅝ in them, a price even at which there was very little profit to be made in dealing. It will be a very good thing when the company's negotiations are settled one way or the other, because the present state of uncertainty is nothing short of harrassing to the shareholders and the market. It is expected that Parliament will be able to deal with the company's Bill before the end of this session, and if this is done, it will be, we sincerely hope, step number one in the settlement of the company's long-protracted wrangle with the Corporation of London.

Other electric lighting issues keep very firm, although not many shares change hands. The time for the declaration of interim dividends is drawing near, and shareholders are keeping their investments until they see what return the past half-year may bring them. It is the steady dividend-payers, St. James's, Westminsters, and Metropolitan, which offer the best inducement for investors in this field, and as there appears to be but little fear of the vestries as competitors, the shares are attractive because of their non-fluctuative character. Given interim distributions upon the leading shares of promising amount, prices will be standing at the end of the year substantially higher than they are to-day.

We have received several inquiries lately as to the Hampstead Electric Company, one of the most recent of electric light creations. There is no price, whatever, for the shares, and it is almost impossible to negotiate a sale.

A slight premium has been established upon the Ordinary issue of the new West London and Provincial Electric Supply Company, and to anyone who stands a likelihood of getting an allotment, our advice is to take the profit at once. The prospectus was as unconvincing a document as we have seen for a long time, and the company is simply a revivification, under a new title, of the Chiswick and Aberystwyth concern which the public refused to take up last year. The vendor is about the only person likely to make money out of it, since he gets £35,000 in cash or cash and shares, for his holding of 35,000 shares (of £1 each, 15s. paid) in the Chiswick and Aberystwyth Company. The West London and Provincial should be left severely alone, although, as we have already stated, the Ordinary shares are $\frac{1}{16}$—$\frac{5}{16}$ premium, and the Preference par to ¼ premium.

In the traction market British Electric are not so good, on account of a reverse which the company suffered in the Midland Counties, one of their light railway proposals being rejected in the Potteries district. This check has led to some selling of the shares, as it was feared that a similar fate might befall other propositions which the company has on hand, but we do not see much ground for the nervousness. New General Electrics are well maintained, and in the tramway division there are buyers about of Anglo-Argentine at 4½. The price is gradually recovering the dividend which was deducted a few weeks back, and we hear very good accounts of the company's progress. Barcelona Trams are a trifle weaker on a fear that all foreign capital in Castile will be heavily taxed in order to meet the Spanish Treasury requirements, but the market does not fear any excessive burden, and it is expecting shortly to hear the terms upon which the company may be taken over.

The telegraph market shows little variation. Anglo-American issues are listless, the absence of business in American rails and of excitement generally in the United States is not conducive to large traffic receipts, and some pessimists profess anxiety as to whether the Deferred stock will get any dividend at all at the end of the financial year. The African lines are in most use at the present time, and we understand that the Eastern Company is doing remarkably well. The fears of an outbreak in the Transvaal, however, act as a heavy drag upon any rise which might be encouraged by good receipts. But the Transvaal trouble overhangs all the markets, and markets are sympathetically flat all round the "House."

In the electric railway market there is a little more doing in City and South London stock, and it can be bought at a fraction over 68. The dealers, however, still refuse to guarantee delivery within any fixed time, as the settlement in the new shares is not definitely announced. We understand that it is likely to take place about the middle of July. The new shares are quoted 4⅜—5, £5 paid. Central Londons remain quiet, while Waterloo and City stock is about 105½. The next dividend is likely to be at the rate of 3 per cent. per annum, and the declaration is due very shortly.

National Telephone shares are barely altered at 4$\frac{11}{16}$—$\frac{13}{16}$, although Mr. Hanbury's speech in the House of Commons on Tuesday night is not regarded as a "bull" point for the company. Were the service to be nationalised forthwith, National Telephone shareholders would be sure of handsome compensation, because the feeling of the country is dead against any infringement of private interests, bad as the existing service is. The new issue of Third Debenture stock is not mentioned.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, June 14th.	Closing Quotation, June 21st.	Business done during week ended June 21st, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	101 —105	101 —105	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	61 — 63	60 — 63	...	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	111½—112½	111 —112	112½	111⅜
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	12½— 13	12½— 12⅜	12⅜	...
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15½— 16	15½— 16	15⅝	15 5/16
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	110 —114	110 —114	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	185 —192	185 —192	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105½	...
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	...	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9½	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9½— 10½	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	102 —105%	102 —105%	...	...
60,710£	Direct United States Cable	20	3 %	3¼ %	...	11⅛— 12	11⅛— 12	12	11 1/16
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	102 —105	102 —105	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	...	165 —170	163 —168	167½	165½
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	100 —104	100 —104	102	100
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	101 —104	101 —104	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	118 —122	118 —122	...	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	16½— 17	16¼— 16⅜	16⅞	16½
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	100 —104	100 —104	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	101 —104	101 —104	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	120 —124	120 —124	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	100 —104	101 —105	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	101 —104	102 —105	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	103 —106	103 —106	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102—105%	102 —105%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	5⅛ %	11½— 12	11½— 12	11⅝	11½
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15½— 16	15½— 16	15 11/16	15½
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	31½— 32½	31½— 32½	...	...
92,600	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	101 —104	101 —104	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	53 — 56	53 — 56	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	109 —112	109 —112	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½ %	6 %	6 %	4½— 5	4½— 5	4 1/16	4⅜
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	12½	12⅜
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	12⅜	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4¾— 5¼	4¾— 5¼	5	4 1/16
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100 —103	100 —103	101¾	101¼
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	105 —108	105 —108	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	131 —136	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4¾— 5¼	4¾— 5¼	...	...
151,783£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	99 —102	100 —103	102	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	103 —106	103 —106	...	...
889,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	106 —109	105 —108	...	...
88,321	West India and Panama Telegraph	10	1 %	2%	...	1⅜— 1⅝	1½— 1½	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10¾	10½— 10¾	10⅝	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	105 —108	105 —108	107½	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	11 — 12	11 — 12	11 7/16	11⅛
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5¾— 6¼	5¾— 6¼	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	8 — 9	8 — 9	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	114 —116	112 —114	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	16 — 17	14 — 16	16⅛	14½
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	15 — 16	13 — 15	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	*nil*	11 — 12	11 — 12	11⅜	11½
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14 — 15	14 — 15	14⅛	...
220,000	Do. 4½% Deb. Stock, Prov. Certs (£60% to be paid) Rd.	...	...	...	...	54 — 56	54 — 56	...	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	...	5½— 5⅝	5½— 5⅝	5⅝	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	7½— 8½	7½— 8½	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6¼— 6⅝	6½— 7	6 11/16	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	106 —108	104 —106 xd	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	16½— 17½	16½— 17½	16⅝	...
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	15½— 16½	15½— 16½	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	118 —121	118 —121	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	16 — 17	16 — 17	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	17 — 18	17 — 18	17½	17
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	4⅛— 4⅜	4⅛— 4⅜	4 5/16	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½— 15½	14½— 15½	15½	15

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation June 14th.	Closing Quotation June 21st.	Business done during week ended June 21st, 1899. Highest	Lowest
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	3 — 3½	3 — 3½	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	18⅛— 19⅛	17½— 18½	18 7/16	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	14 — 14½	14 — 14½	14½	14⅛
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	13⅞— 14½	13⅞— 14½	14 1/16	13 15/16
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	126 —129	128⅝	127
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	1⅞— 2⅛	1⅞— 2⅛	2	1⅞
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2¼— 2½	2¼— 2½	2 5/16	...
125,000	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	103 —106	103 —106	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13½— 14½	14 — 15	14 15/16	14⅝
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	114 —117	114 —117	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10⅜— 11¼	10½— 11	11¼	11
178,303	Do. do. do. £8 paid	10	...	...	...	8⅞— 9½	8½— 9	8⅞	...
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	3 — 3½	3 — 3½	...	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	5½— 6	5½— 6	5 15/16	5¾
630,000	City and South London Railway	Stock	1 1/16 %	1⅞ %	2⅛ %	67 — 69	67 — 69	...	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £5 pd.	10	...	...	...	4¾— 5¼	4¾— 5¼	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3¾— 4¼	3¾— 4¼	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½ %	6 %	...	2 — 2½	2 — 2½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½ %	6 %	...	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	96 — 98	97 — 99	98¼	97½
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2¼— 2½	2¼— 2½	2¼	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,800	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝— ¾	⅝— ¾	...	...
9,600	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	...	10 — 12	10 — 12	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	25 — 26	24½— 25½	25⅜	24¾
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18 — 20	18 — 20	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	112 —115	112 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21½	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	101 —105	101 —105	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½ %	3½ %	3½ %	8⅝— 8⅞	8⅜— 8⅝	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	14 — 14½	14 — 14½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	40	38¾
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	105 —108	105 —108	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¾— 10¼	9½— 10 xd	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5¾— 6¼	5¾— 6¼	5⅞	...
540,000	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	105 —108	105 —108	105	...

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10¼.
British Aluminium, Ordinary, 10½—11; 7 % Pref., 12—13.
House-to-House, 4½% Debentures of £100, 105—108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7⅛—8. Debentures, 105—108. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 5/16—7/16
Smithfield Market Electric, 2—4.
*T. Parker, £10 (fully paid), 17.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, June 21st.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a " Nitric .. .. .. per cwt.	22/-	22/-	..
a " Oxalic .. .. .. per cwt.	32/-	32/-	..
a " Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	37/-	37/-	..
a Ammonia, Muriate (crystal) .. per ton	£26	£26	..
a " " .. .. per ton	£24	£24	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a " (50/90 %) .. .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£27	£27	..
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a " White Sugar .. .. per ton	£31	£31	..
a " Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	2½d.	2½d.	..
a " Caustic (75/80 %) .. per ton	£24	£24	..
a " Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6 5	£6 10	5/- dec.
a " Recovered .. .. per ton	£5 10	£5 10	..
a " Lump .. .. .. per ton	£5 0	£5 0	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a " Crystals .. .. .. per ton	£3	£3	..
a " Bichromate, casks .. per lb.	2½d.	2¾d.	..
METALS, &c.			
b Aluminium Wire, in ton lots .. per ton	£294	£294	..
b " Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£55 to £137	£55 to £137	..
c Brass (rolled metal 2" to 12") basis per lb.	8½d.	8½d.	..
c " Tube (brazed) .. .. per lb.	10½d.	10½d.	..
" Wire, basis .. .. per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).	This week.	Last week.	Increase or Decrease.
f Ebonite Rod .. .. .. per lb.	3/-	3/-	..
f " Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£86	£86	..
g " Wire (basis price) .. per lb.	10½d.	10½d.	..
g " Sheet .. .. .. per ton	£86	£86	..
g " Rod .. .. .. per ton	£85	£85	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/0½ to 4/1½	4/0½	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i " Pig (Cleveland warrants) per ton	64/-	60/11	3/1 inc.
i " Forgings, according to size per ton	From £11	From £11	..
i " Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i " Wire galvanised No. 8 .. per ton	£10 12 6	£10 12 6	..
g Lead, English Ingot .. .. per ton	£14 7 6	£14 7 6	..
g " Sheet .. .. per ton	£15 7 6	£15 7 6	..
l Mica (uncut slabs 8" long) .. per lb.	6/8	6/8	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 5	£8 5	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p r'l'd strip & sheet per lb.	From 1/2½	From 1/3½	..
o Platinum .. .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£120 10	£120 10	..
g " foil .. .. per lb.	1/6	1/6	..
n " wire Nos. 1 to 16 .. .. per lb.	1/7	1/7	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £65	£40 to £65	..
j Yarns, Cotton, Single 10lb. bundle s pr lb.	7½d.	7½d.	..
j " Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j " Hemp, 3 ply 10 lbs. .. per lb.	3½d.	3½d.	..
j " " Russian, 10 lbs. per lb.	4½d.	4½d.	..
j " Jute, 180 lbs. rove .. per ton	£12	£12	..
j " Manila, 24 thread .. per ton	£32 10	£32 10	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£31	£31 10	10s. dec.

ations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
l Messrs. Sanders, Wake & Co.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

MUNICIPAL ELECTRICAL ASSOCIATION.

After the reading of Mr. Faraday Proctor's presidential address, which appeared in our last issue,

Mr. Dixon, Bradford, moved a vote of thanks to the President, who, he said, had read one of the most interesting addresses given before that Association; it touched on so many topics. One thing in particular he would allude to—that which had reference to subways under the roads necessary when they began laying electrical cables. An enormous amount of money was thrown away by municipalities in taking up and relaying roadways; that must be clear to anyone. With regard to municipal *versus* private enterprises, he was afraid there was a little too much truth in the assertion they did not get quite value for their money in connection with Corporations, but as far as the electrical part was concerned, he felt that that was an exception which proved the rule. They were satisfied in connection with the Bradford Corporation, at all events as far as the electrical works were concerned, things were so well overhauled and supervised that they got full value for their money. He took it that Bradford would show such a favourable comparison with others that they would agree as far as that town was concerned, its works were fairly well managed, and that if they did not get value for money they could not possibly show such results. There were other corporations who could probably speak on the same lines. He thought that one engineer should have the whole control in municipal corporation works. Where there were two or three interested parties it must lead to expense and extravagance. One of the most important of all the things alluded to by the President, was the fact that new electrical enterprises were called upon to pay interest and sinking fund charges at so early a date; that was a little bit arbitrary. If the Local Government Board would only allow a year or two to elapse before imposing such charges probably there would be more works put down than at the present time. He had pleasure in moving that the best thanks be given to the President for such an able address.

Discussion on Mr. Pearson's Paper.

The President suggested that all members of the Association, were, of course, municipal traders, and it might be a very good thing if they could get several who were not members of the Association to aid them in their discussion. He called upon Mr. S. Z. de Ferranti.

Mr. de Ferranti, in responding to this invitation, said he had very little sympathy with municipal trading, as a fact, in existence to-day. He had read with very great pleasure Mr. Pearson's able paper, and once reading it had produced, notwithstanding his natural prejudice, a very considerable feeling in its favour which he did not possess before. He had said that he did not sympathise with municipal trading as a fact. He had often thought in reading discussions which had taken place in Parliament "What a pity it is that so and so is such an able speaker," when he failed to agree that the views he put forward were right. He thought when views were not strictly right in principle it was unfortunate that they were advocated by a singularly able man. He felt that example was very applicable to the present case. He thought Mr. Pearson, and the President also, in his address, advocated socialism. Socialism altogether might not be bad, but he thought there was a good deal that was bad in it. Although Mr. Pearson desired that individual enterprise and effort should be in no way restrained by this, he considered that in the long run it tended to restrain it. With reference to the paper, he noticed that Mr. Pearson called a number of expenditures made by municipalities, commercial investments, and it was against these commercial investments that he felt most strongly. He was fully aware that public companies were not by any means immaculate, in fact, he thought in many cases public companies were far less well managed and less well run as business concerns than municipalities. Still, he would like to see everything which was done in the country, out of which a commercial profit could be made, left to ordinary commercial undertakings, and he would like to see municipalities confine themselves to what he called the essential works which people would not take up in the ordinary way of profit making. They had at first one thing, say, water, which was a necessity, then they went to other things which they began to think were also necessities. They went on to electric lighting, which he was afraid he must say was such a good thing that in the hands of monopolists it was hard to make it do anything but succeed. They might say this was an excellent example of municipal trading, but they might go on from one thing to another until there was nothing left for individual enterprise to do. It might be that he was taking the two extremes, but he would rather put it in an extreme unprejudiced way so that they might see as municipal traders the other side of the question, and form their own conclusions as to the course to be adopted and the wisest way in which to act in future. The principal thing, to be more moderate, he would like to say, was this—and he dared say many municipal traders would agree with him—he must admit municipal trading was a good thing where large capital in the way of works was required. On the other hand, he thought any municipal trading which would require a very large employment of labour would be essentially bad. He thought the more that was left to private individuals to discuss among themselves and fight out and bring down to a market basis, the better. Undoubtedly the fact that the corporations could get cheap money was a good thing for all these undertakings employing small labour and very large capital investment, but on the other hand, he would like to see the line drawn as much as possible where labour and individuals were to be dealt with as against large capital expenditures. The paper of Mr. Pearson's had very much modified his views on the subject, and he hoped they would excuse his coming there and offering those opinions seeing the point of view he had looked at the subject from. There was no doubt about the very great success which they had made in electrical municipal trading, and every credit was due to the municipalities and engineers for the great work which had been done.

The Mayor of Halifax explained that he had not had the advantage of reading Mr. Pearson's paper. One could not help feeling there was a great deal of truth in what the last speaker had said, and could not help feeling, too, that he must have had a great deal of trouble at some time or other with his employés. He (the Mayor of Halifax) came from a town which was distinctly Radical, and very much of the influence that was brought to bear upon the Council he had the pleasure of representing, was brought to bear by the working classes. If any great scheme was to be brought about, it was generally brought about in a mass meeting by the working classes. For instance, three or four years ago they were talking of tramways. A company was prepared to come to his town to work tramways, and when he stated they had never had tramways until 12 months ago, they would understand it was considered a risky undertaking. The company was prepared to lay out £200,000 or £250,000, and many were inclined to hold out the hand of welcome to the company thus prepared to spend their money lavishly in the town in a way which many thought would not produce for the company any great good. The generality of the ratepayers took a very lax interest in the matter, but the workers of the town held a mass meeting and practically packed that meeting and determined the trams should be run upon municipal lines. Their chief aim and object was the welfare of the workers; that they should be well paid seemed to be perhaps one of the principal items in the discussion, and the argument that the Council should be exemplary employers of labour was made a great deal of. Well, now, he could not help being pleased to think that by the efforts of the meeting the company was kept out. The municipality promoted a Bill, constructed tramways, and these had been eminently successful—successful beyond the wildest anticipations of anyone in the town. They had been now running 12 months; they were looked upon as model tramways working under the utmost difficulties as far as steep gradients and narrow tortuous roadways. They had made the fare a very low one, a humble penny carrying the rider to any part of the tramway at present existing. When he said the gradients were as great as 1 in 10 they would understand the enormous cost entailed in running these trams, yet they had made them a great financial success. Not only so, but they had shown themselves model employers of labour. Much of their success was due to their late eminent engineer whom they were sorry to lose.

Mr. W. A. Todd (a member of the City Council of Bristol) said no doubt the corporation was a very good employer usually, but the managing committee was subject to changes which might alter at once the policy of the undertaking. It was difficult to conduct a business undertaking where a change of policy was possible, and any system which was subject to this drawback was bad. A really business undertaking needed to be judged from the standpoint of success. They might take it the corporation would always conduct business upon honourable and proper lines. They knew that companies were not always conducted on those lines. The great danger from the point of view of the corporation as employers was the change of policy that might arbitrarily take place owing to members of different views being elected upon committees. As regards employés there was sometimes a difficulty in corporation officers dealing with business. Corporation officers were very loyal to each other, and he did not care what the undertaking might be they could not get all men of equal capacity, and there must be in a large business some whose capacity was not equal to the work they might have to undertake. This was generally accepted by colleagues, but the civic committee chiefly responsible were not so conversant with the facts as in the interests of the business they should be. In a business carried on by a board of directors, the chances were that the incapables were well known; there was power to make a change, and no thought was given to the matter by their colleagues because the changes came in the ordinary carrying on of a business undertaking. Things were, however, very different when they came to an official belonging to a corporation who had done everything possible according to his ability for the benefit of the corporation, and there was a feeling that the committee would be dealing harshly with such an official if a change was made, and there were friends of the official who would see that his interests were fairly well looked after, and thus the committee were hampered in dealing with their business by outside influences. Consequently the undertaking suffered. There was another point. The Mayor of Halifax had said a mass meeting decided in favour of the tramways in his town. They would probably all agree it would be a dangerous thing to allow mass meetings to decide the nature of the undertakings of the corporation. They might have all sorts of things decided by mass meetings. Nobody looked with greater sympathy and nobody with greater admiration upon Mr. Pearson's municipal work than he did, but Mr. Pearson imposed limitations in this matter, and to those limitations he (Mr. Todd) would add that the municipality should undertake nothing in the way of trading except that which individuals could not touch, and yet which it was for the interest of the citizens they should have.

Bailie Maclay said with regard to the subject itself, he might say he was completely in sympathy with Mr. Pearson with regard to municipal trading. He thought that wherever there was a monopoly in any borough that monopoly ought to be in the hands of the municipality. If there was to be any profit derived from that monopoly then the monopoly should be in the hands of the municipality, and the profit should be for the benefit of the community as a whole. There was just as much scope and opportunity should they say, for mismanagement, not to say cor-

ruption, with a company as with a corporation, and that was his opinion. It was said that a private company could with greater ease and celerity change its servants if they were not giving satisfaction, but that gave less inducement to a man to come to these private companies. Really capable men and men of integrity, when they found that under a municipality they could have something like security of tenure were more likely to be attracted towards a corporation, where they could often depend upon a good remuneration.

Mr. S. Lloyd (Bristol) having been engaged with Mr. Pearson in municipal matters in Bristol, would like to say that the opinions expressed in the paper were very much those which he had entertained. He maintained that the government of a city should be for the benefit of the people in that city generally. Works which were absolutely necessary for the city were safer in the hands of a municipality than any private company, because the latter were beyond the control of anyone outside their own shareholders, and their only object was the making of high dividends, whereas the control of the municipality was under the direction of the ratepayers, who were benefitted or otherwise by the enterprise. As the Mayor of Halifax had said, even mass meetings were sometimes right in the decision to which they came. He regretted very much that in Bristol they had not been able to obtain the monopolies which ought to be the possession of a municipality. They had not the gas, the water, or the trams, but they had secured the electric light, which had been a very great success. It was a very great trouble to him that the tramways of the city had not been secured by the corporation, so that they might have been worked under the one engineer. Visitors to the Conference would see the way in which the streets of the city were being broken up and obstructed without any joint action on the part of the citizens' representatives. The Tramway Company had obtained a Bill in Parliament, in his opinion it was a great mistake for the city to have allowed the Bill to go through without taking greater precautions, and they were to-day at their own sweet will breaking up the city in all directions. Then the Waterworks Company came along and broke up the streets, and they would be followed by the Gas Company. Between these various bodies the citizens of Bristol were put to a very large expense in keeping the streets in the state they ought to be. This was an illustration of the folly of allowing the control of matters which were essentially municipal slip out of the hands of the Corporation, thus entailing very great cost in all directions. He believed that within certain limits municipalities of the kingdom ought to have control of those matters which affected the citizens, and he was very hopeful that a system of municipal trading within right and proper limits would spread more and more throughout the country in the interests of the people, rather than in the interests of those who were making profits by large companies. It seemed to him that a very great danger in the future of this country was that undertakings would get into the hands of trusts and large bodies, who would control them as a monopoly against the interests of the general public. They wanted some bodies with sufficient capital and sufficient power to insist upon there being competition in the interests of the people generally.

Alderman Calvert (Huddersfield) said he felt that the last speaker had touched upon some of the main points upon the subject of municipal trading. Mr. Ferranti and another gentleman had spoken against municipalities trading, but had admitted there was a class of work impossible for the corporation to take in hand, but they did not point out what these works were. He (Alderman Calvert) was of opinion that municipalities should have control of works which interfered with the streets. Those who went into the streets for any purpose—electricity, water, gas, or any other commodity necessary to supply the citizens, should be under municipal government. He had had some considerable experience of municipal corporations, and he found that there never was any fear of the policy of a committee being greatly changed. Men might be taken off certain committees, men would lose their seats at November elections, but the same policy would be carried on in the future; by the introduction of a few new members the policy was not interfered with. Another reason why he thought that Corporations or District Councils should take these matters in hand was, that in course of time when the Corporation had to buy the undertaking they had to pay through the nose. At Sheffield, in the winding-up of the Electrical Company, they found a case in point. Had the Sheffield municipality taken that matter up in the first place instead of waiting until a few people had made it a success the municipality would have received the benefits now received by a few people. Corporations had no right to go into a trade which could be better done by a private individual. Anything which could only be done by a municipality or by a company it was better should be done by the Corporation. He must express his admiration of Mr. Pearson's paper.

Alderman Richards (Bedford) who confessed that he had not read Mr. Pearson's paper, spoke of his experience of municipal trading in Bedford. When the question of electric lighting came to the front, a company was formed to run the electric light. The corporation consisted largely of directors and shareholders in the gas company, and the consequence was, great difficulties arose with regard to the corporation taking the matter up. Then the electric light company was formed, but to a very great extent the directors and the proposed shareholders of this electric lighting company were, upon investigation, found to consist of the shareholders and directors of the gas company. The consequence was, it seemed to some of them in the corporation, there would be a double monopoly—that the gas and electric light would be locked up in one monopoly—practically the thing would be in the hands of the gas company. There was a very stiff fight, the members, of which he was one, won, and the Corporation ran the electricity works, and to a great extent they had been successful. Remarks made that day explained why they had not been so successful as they might—they had to pay back loans as soon as they borrowed the money and before they had an opportunity of recouping themselves. They had paid their way and made a profit, with the exception of paying back the instalment on loans. Their opponents in the gas company turned round and said: "So much money has to come from the rates to maintain electric light." That was entirely unfair, electric lighting undertakings must be efficient to be run—the machinery, cables, &c., must be in a state of efficiency or it could not be run, and when anything was required with regard to repairs that had been done and had been charged to the works account. The consequence was, that had to come from profits and still they had during the first five or six years to pay thousands back of the money they had borrowed, and this had to come as far as it could from profits and then from the rates. Opponents forgot they had a good property which certainly did not depreciate to any great extent. He did not believe in socialism, but he did believe in corporations having control of the streets and of the interests that the ratepayers required. Water was a necessity; he thought artificial light was a necessity. Whatever a company could do for profit he thought it was the duty of corporations and municipalities to do for the benefit of the ratepayers.

Mr. Chamen (Glasgow) said, personally, he could speak from experience of both corporations and companies. He had been on both sides of the hedge. All these arguments about the possibilities of corruption and the various difficulties existed exactly alike on both sides. Of the two give him the Corporation. It had been sometimes said that he had 78 masters. That was true, but there was safety in numbers. There was a point upon which some members would like an opinion. He referred to the question of commercial municipal trading. How far should they go in hiring out motors and apparatus of that kind? That had been done in some cases, and he thought it would be a pity for the Conference to pass away from the subject without having an expression of opinion on the point, which was a very important one. He would like to ask Mr. Ferranti point blank what he meant. How far should they go? Did he mean that electric lighting and tramways should be managed by municipalities or not? No one had a greater admiration for Mr. Ferranti's ingenuity than he had, but he thought Mr. Ferranti had been playing rather low down that time. Let him say in plain English what he meant.

Alderman Grime (Blackpool) thought the paper would have been more appropriate in an assembly of public men or persons connected solely with municipalities. It had a bearing in an electrical sense, but it had a more general bearing. The Mayor of Halifax had referred to outside influences and public meetings. Blackpool differed from Halifax in that it was Conservative, and he was bold enough to say there was not a more progressive town in England to-day. And yet the masses would not come to meetings. They had practically no working classes in the borough. If there was an unprogressive power in the place it was the men. Members of the Corporation were Progressive, and the public meetings and mass meetings were generally of a non-progressive character. It was a common secret that many of the works contemplated by corporations often failed to get the necessary confirmation. In this matter of trading it was necessary for a community, whether it was a village or a city, to conserve and hold fast to the necessaries of life. In the case of large cities where the water, gas, trams, and electric light were concerned—works involving a large expenditure—he as a Conservative was democratic enough to say that the idea of municipal life was to hold fast to these things for the benefit of the many.

Mr. Jenkinson thought that many opponents of municipal trading would perhaps agree with Mr. Pearson that tramways, gas, and electric light undertakings should be in the hands of the municipal authorities, but it was when it came to interfering with the smaller ratepayer or shopkeeper that people who otherwise agreed with municipal trading would oppose it. Let them take the supply of fittings, for instance, gas or electric light fittings, or the carrying out of installation work. It was here that he thought many opponents of municipal trading drew the line. He was in favour of corporations owning the larger monopolies.

Mr. Ferranti could not help being amused at Mr. Chamen's remarks as to what he (the speaker) meant. In the first place, it must be very obvious to them that it was not his business to come there at their kind invitation and venture to teach them their business or even suggest it. He came there to be instructed, besides the general pleasure of meeting all of them interested in that profession. In the second place, if he might in a public meeting quite privately recommend them to go in, say, for the manufacture of dynamos, they would all have such a keen interest for the pockets of the ratepayers that he was sure they would not mind his telling them they would be unwise to go into any such thing. With regard to the general principle, he might carry the matter again to an absurd extent. It had been said that everything which was really necessary to the community should be done by the municipalities. Why then should they not supply bread? Of course, it was only carrying the argument to an absurd extent, and he did not propose to put it before them seriously. (A voice: "Bread is not a monopoly.") It certainly was not, but some speakers had said that everything which was essential should be supplied by the municipality. They did not want their streets broken up, but horses and carts going about, though a necessity, interfered with them. It was not for an individual to exactly define what a municipality should or should not do. They must leave it to the undoubted common sense of the nation at large to decide how much it would have done by its municipalities. He was sure that that common sense would triumph, and put the proper limit upon such undertakings.

Mr. Steinitz (West Ham) said he did not agree with a municipality trading for profit, and he proceeded to refer to the difficulty of getting local authorities to agree among each other in matters such as common sewage schemes. Mr. Pearson had argued that work was always carried out better by a corporation than a contractor, but

that, of course, was a matter of opinion. It was said that the work was entrusted to a sub-committee, but it had to come afterwards under the review of the full committee and the Council, and doubtless many of them knew cases in which the Council had sent the matter back. As to street lighting, he said that a corporation owning their own electrical works would adopt electric lighting if it cost 50 per cent. more than gas, but they would not think of paying a company 50 per cent. more.

Mr. Dixon (Bradford) included water, gas, electric trams, markets, and electric lighting among the things which he thought corporations should take in hand. In Bradford the Technical College had been taken over, and (he was understood to say) they were thinking of taking over the hospitals. In all municipalisations they must give credit to private enterprise. He did not remember a single instance where a municipal corporation had taken anything in hand that had been in its infancy. They had waited to see that it was made a success by private enterprise. His corporation had constantly to face difficulties which did not come from the workmen themselves. There were outside agitators who gave more trouble than any of their own men. The corporation were dictated to by men who knew absolutely nothing of the business; they were even outside the town and dictated the hours of work, the wages to be paid, whether foremen should belong to the union. This was a danger they had to face, and if municipal corporations put their shoulders together and stood against these influences, it would enable them to work on a business-like basis.

Mr. Gibbings (Bradford) did not think it was possible in the present day, in England or America, to find a substitute for the natural incentive of the individual, and either by education or anything else to get into the condition represented in "Looking Backward." The incentive of individual effort would always in the long run decide these great questions—questions of the personal investment of money and so on, and as to how far any undertaking should be owned by the municipality or by a private company.

Mr. Butterworth (Derby) pointed out that this question was pressing itself upon public attention to a large extent. The reader of the paper said he would not have municipalities take anything on which would seriously encroach upon the work that could be well done by the private individual. Mr. Ferranti, in his remarks, excepted from his general depreciation of the principle of municipal trading such things as waterworks, gasworks, markets, and workmen's dwellings which could only be dealt with by municipalities in as much as these various matters involved the principle of monopolies, and monopolies ought to exist only for the purpose of the good of the people affected by the exercise of the monopoly. He rather thought the opponents of the system of municipal trading were those whose interests might to a large extent be affected by the carrying out of the principle of municipal trading. He had one or two friends who were quite determinedly opposed to this principle, but when they ascertained what the businesses were, they saw at once that they feared that they would be affected very much if this principle be universally adopted. Any person there, short of an out-and-out socialist, would deprecate municipalities who went in for the manufacture of certain goods which had been from time immemorial carried on by private enterprise, and which it was quite possible should be carried on by private enterprise. There was the question how far they should go in the supply of apparatus for the use of the electric current. Almost all municipal corporations and works supplied lamps at the present time. It was to the advantage of the customer and the distributor of electricity, that the best lamps should be used. How far would they carry that principle? Would they carry it so far as to wire houses? Would they supply electric fittings as well as wire the houses and supply the current? As far as he was concerned, if he felt that there was a desire for it, and if these businesses were not properly supplied by private enterprise, he should have no hesitation in recommending the Council to supply fittings and do the wiring in the houses. He could not see any reason why it should not be done, if not already done efficiently, and at a moderate expense.

Mr. Pearson was then asked by the President to reply. He said: As to his ideas being socialistic, he would not shy at words. If there was any good in what socialists advocated he would adopt it, notwithstanding that some of his friends might profess to be frightened at socialistic doctrine. Why should he hesitate to follow a socialistic proposal which was common sense? He had attempted to limit what he considered should be the action of corporations. He had said he thought municipal trading should be confined to the provision of those necessaries of civilisation which were beyond the power of individual effort, and which did not fall within the purview of a Government department. He (Mr. Pearson) had limited himself to water, lighting, and a cheap mode of progress from point to point in a town, such as tramways. If he found legitimate and proper competition between tradesmen, he was prepared to leave the ordinary everyday requirements of life in the hands of tradesmen and private individuals, because he believed, taking the nation as a whole, no corporation or company would ever trade so economically as a private individual trading for his own profit. Anything within his reach should be left to the private individual, but when there was an utter lack of trading competition and a practical agreement among large contractors which precluded their considering for one moment that there was the slightest attempt at competition, he was prepared to go much beyond the definition he had laid down in his paper. When they found in a city two men competing, and they always found them doing the same thing, and, by a strange coincidence, the same time of finishing the contract occurred to the minds of both, and whichever got the work it was always divided, he thought it was time for them not to tie themselves to titles or distinctions, but to consider whether they were being fairly dealt with. The moment they found that they were not, let them take the matter into their own hands. That would shortly explain his position rather than a definition in words. Given fair competition, he was prepared to encourage the private individual, but sometimes corporations were looked upon as fair game to go for, and then it behoved corporations to be wise, and not to tie themselves to a definition, or bother their heads about whether it was socialistic or not, but to set to work and do the job themselves. There was a great deal in common to discuss between the municipal trader and the anti-municipal trader. The difficulties as to labour were undoubtedly the greatest the municipalities had to face. The fact that he admitted it was a serious difficulty did not suggest for a moment that it was insuperable. He knew that pressure was brought to bear by working men either directly or through their representatives. But he had never found yet—perhaps he might later on—that determined opposition, based on lines of common sense, did not ultimately weigh with working men. He believed working men were not deficient in common sense. They would use their power to further their own interests the same as all the rest of them, and that was a thing authorities must be prepared to face, but it was a difficulty he had not yet felt to be a very great one. He had had to meet the working classes, and he had been opposed by them and supported by them, just as they thought he was furthering their ends or somebody else's, but he had never found that he or any other man had been opposed unfairly. The chief difficulty they had to fear arose out of the organisation of the labour of the country which was now going on. It was a difficulty common to companies as well as to corporations, and he thought municipalities could deal fairly well with the labour question. At any rate, they had dealt fairly well with it up to now. As to the difficulty of getting localities to join in schemes, he thought the difficulty of two companies coming to terms would be very much the same as two corporations. He had had considerable experience of negotiating with adjoining localities, and he found they would agree with him if they thought they were going to get anything out of him. If they thought he wanted to get something out of them, he would be met with a very cordial opposition. The same thing would happen if he represented a company. As the education of municipalities was growing, and Parliament reflected the opinion of the country, they found growing now very strongly—and it would grow much stronger—the idea of combination for water supply. They would find that when two or three localities were competing for a common source of supply, Parliament would compel them to join and take it rather than they should fight over which one was to have it, and that that one should make a profit out of the others. When they considered the lines Parliament was going upon and the growth of the combination theory in Parliament, as evidenced by recent action, they must be convinced that common and joint action, particularly upon subjects of water and drainage, would be much more common than at present. It would come at no distant date. As to street lighting, he mentioned that the authority whom he had quoted was a London engineer who had the management of a station, and who would have no interest in misleading him. The finest return they could make for a town which dealt in electricity was to give it a brilliant illuminant over the whole year. They had 300 arc lamps in Bristol, and he should not be satisfied until the number reached 1,000, if not more. He did not think any difficulty was likely to arise as to public lighting when it was in the hands of the Corporation. They might rely upon the individual jealousies of their fellow citizens in the matter of illumination. When they wanted to get an extension of the lighting in Bristol they said if they did not give a little electric lighting to every part of the city by going out to the very edge of the city in every direction, they would never carry a scheme at all, because no members of the Council would support a scheme which gave all the lighting in one direction; and very properly so too. They had adopted the plan he had mentioned and it had worked exceedingly well. He hoped it would work better at no distant date. In conclusion, he did not think the difficulties of municipal trading so great as had been imagined.

Discussion on Bailie Maclay's Paper on "Appropriation of Profits and Repayment of Loans."*

Mr. Pearson, whose name had been mentioned by the author of the paper, was asked to open the discussion. He said really and truly they were actually in accord. His only doubt was whether Glasgow was keeping strictly within the Electric Lighting Act. But it seemed that Glasgow had some old Act which Bristol had not. Bristol was at the present moment trying an experiment which Glasgow had tried with such eminent success. He felt that something was necessary to strengthen their position in the way of reserve fund, and there was a doubt whether they had a right to create a depreciation fund. He was so impressed with the wisdom of putting as much as they could to reserve and depreciation, that they had paid £2,000 to start a depreciation fund, and were going to send the account to the Board of Trade, and hoped for the same Christian charity as Glasgow had received. If he found the Board of Trade would sanction a depreciation as well as a reserve fund, part of the profits of Bristol would be paid into depreciation as well as reserve.

Dr. Parton (Bolton) suggested that they would gain something if the Association, by bringing pressure on high quarters, could obtain some uniformity in the repayment of loans throughout the kingdom. Such a course would be much to the advantage of municipal electrical enterprise. London was able to borrow for repayment in 35 years; provincial authorities could only borrow for 25. All would agree they should have reserve and depreciation funds; the balance of profit they were obliged to give to the benefit of the rates. In the early stage there were certain losses the ratepayers made up, and it was only fair to the ratepayers, if it was necessary for them to make up losses, that they should have at least some share in any profit which such

* Electrical Review, June 16th, p. 996.

an undertaking might make in later years. He did not think it was desirable in the case of electric lighting undertakings that profits should be large. There should be a small working profit. If municipalities were making a large profit on lighting, they were treating their municipality unfairly.

Mr. Mountain (Huddersfield) mentioned that in his town they had made a profit, and since they had done so they had had more trouble than before. Alluding to the points which company engineers were taking up, he said they talked of profits after having a sinking fund. In many cases profits after meeting sinking fund charges were *nil*. That was one reason why they needed an extension of the time for the repayment of loans. Twenty-five years was too short. Some time was needed to begin the works. The question of profits seriously affected small undertakings, and many towns could not start because they were afraid of a loss.

Mr. Dixon said at Bradford they began years ago laying sums aside for depreciation, and it had never been questioned yet.

Mr. Boot, of Tunbridge Wells, referred to the basis on which corporations reckoned their profit. In companies it was usual for secretarial, audit, and other expenses to be charged to the account, but his inquiries in 36 towns showed that nothing was charged for the borough accountant's and town clerk's services to the committee and undertaking. A few towns jumped at a conclusion the other way, with the result that sums out of proportion to the services rendered were charged against these accounts. Unfortunately his town was one of sufferers in that direction. It would be well if the Council of that Association would take the matter into consideration, and endeavour, if possible, to arrange either according to the number of consumers or according to the capital outlay, or the revenue what they considered a fair sum for services rendered by outside officials. Many towns which declared their profits without reckoning anything at all showed a profit that was fallacious. He would like to propose that the Council of our Association should take this matter into early consideration, and draw up a report, which report can be circulated amongst the chairmen and committee for the purpose of arriving at some basis of charging outside officers' services and establishment charges to the undertaking.

The President suggested that the resolution should be submitted to the meeting of members only, to be held on Saturday.

Mr. Boot agreed with this proposal, and did not proceed with his motion.

Alderman Bray (Plymouth) explained that a charge was made for the services of the town clerk and borough surveyor, and a proportion of the rent of the Guildhall at Plymouth, and it amounted to nearly £500 a year. That was charged to their revenue account. Their undertaking being a small one, they felt that it added a serious tax to their already overburdened undertaking. They had brought the matter before the Finance Committee to see if there could not be some arrangement for lessening the amount, and they were making inquiry as to how the figures were arrived at. It was done by the borough treasurer in this way. They had a sanitary authority and a municipal authority, and half of the total cost of establishment expenses was debited to sanitary and half to municipal, and the latter was divided between receiving committees and non-receiving committees. The receiving committees were those that received revenue—such as from trams and water rents—and the expense was divided in proportion to the amount they received. The Water Committee had a very large income—something like £25,000 a year—and were paying a profit to the town. They paid their share, and a committee which could scarcely pay interest and sinking fund had to pay as well. The expenses of the Electrical Committee might increase as the receipts increased, and the profits might not be larger. The Finance Committee declined to interfere in the matter, and so they remained as they were. He hoped that the experience of gentlemen from other parts of the country would enable them to formulate some fresh system by which matters might be adjusted.

Mr. Calvert said it was really a case of taking the money out of one pocket and putting it into another, but it affected the electrical engineer, who was not able to show quite as good results financially as he otherwise would.

Alderman W. Potter (Taunton) said that at Taunton they paid the borough accountant for keeping the accounts. The fact was, that for some years the electric light undertaking was carried on by a company, and when it was taken over by the Corporation the sum that was paid to the secretary for keeping the accounts was given to the borough accountant for the extra work it entailed. He thought that was only right. He expressed cordial approval of the paper of Bailie Maclay. The absolute necessity of going in for a reserve fund and depreciation fund could not be too forcibly impressed upon them. They had had an illustration of this at Taunton. As most of them were probably aware Taunton was one of the first towns in the kingdom to go in for municipal electric lighting. Their plant had become necessarily somewhat obsolete, and when this expression had been used their opponents had interpreted it to mean worn out and useless. What he meant was that it was not as economical as the present day plant would be. Consequently they were advised to change it and go in for new. The Local Government Board met them in this way—their old alternating plant stood on their books at a certain price, and as they were able to get that price for it—the full amount at which it stood on their books—the Board allowed them to borrow what money was necessary for putting down new alternating plant, taking into consideration, of course, the amount they were to get for the old. But as regarded the arc plant, inasmuch as it was impossible that they could realise anything like the amount which stood in their books, they could not borrow. The consequence was that the difference between the amount they could get by the sale of their old arc plant, and what it would cost to put down new, had to be met by a depreciation fund. If they had had no depreciation fund they would have had a big debt hanging round their necks for a long time. The installation at Taunton was comparatively small, but they had, he was glad to say, turned the tide. For two years they had not only been paying all the interest and sinking fund accounts, but they had also made a profit, which showed that they were in a fair way of doing well. He quite agreed with the remarks as to the prior claims of consumers when there were profits. He had very little sympathy with those ratepayers who stood aloof and did nothing to make the electric light undertaking a success, but who used every opportunity to cry it down, and to throw obstacles in the way of the committee. They were the very last men he would give the benefit of any profits to. He maintained that the men who had made the electric light undertaking a success, who had paid more for several years for the light than they would have done for gas, were entitled to be considered. He quite agreed that the general community of ratepayers participated in the benefits arising from the adoption of the electric light. They did so in many ways. If the profit from the undertaking enabled them to reduce the cost of street lighting—as at Glasgow—then the general body of ratepayers participated in that reduction. But the people who used the light and made it a success, who paid the interest and sinking fund, and were thus securing to the town within 25 years a very valuable property, were entitled to their first consideration. As a matter of business, it was wise to make the charge as low as possible, as by so doing they considerably increased their business.

Bailie Maclay (Glasgow) then replied: He said he wanted to emphasise this. In the city of Glasgow they never had been accustomed to go to the rates for the deficit. Therefore he failed to appreciate some of the remarks about the risk to the ratepayers. The ratepayers never had any risks at Glasgow; they in Glasgow were entirely opposed to utilising or appropriating one penny of their profits for the reduction of the rates of the city. They did not believe in it. They never got anything from the rates, and did not think there was any call to give the ratepayers anything back. The number using the electric current was comparatively small, and they had to be careful how they dealt with them. At the beginning of their career in Glasgow they had some deficits; their electricity undertaking did not pay the first year, but the balances were carried forward against them.

Dr. Panton: Is not that contrary to the law which says you must pay it from the rates?

Bailie Maclay, amidst some laughter, explained that they commenced business as a sub-committee of the Gas Committee, and enjoyed some of the Gas Committee's privileges. The Gas Committee paid their deficits, but debited the electrical undertaking with them. What really happened was this: Those who were consumers of the electric current for the first year or two got the current under cost. Would they ask the general community to pay under such circumstances? Certainly not. As soon as the undertaking became profitable the loss was paid back.

NOTES ON DISTRIBUTION OF ELECTRICITY.

By Charles D. Tait.

Borough Electrical Engineer, Southport.

Now that the supply of electricity for lighting purposes has developed to so large an industry that no town in Great Britain with any pretensions to progress is without its electricity works, it may be of interest to briefly examine some of the changes in distribution, more especially in alternating current practice, which have taken place during the last few years, and to observe how the general use of electricity is restricted by the burden of capital charges.

A few years ago, when a great number of alternating current stations were being designed, it was the orthodox practice to supply consumers, if not from house transformers solely, at any rate from a conbination of house transformers and street transformers. The latter were buried in the ground, usually with their switch gear and fuses in the top of the cast-iron case containing the transformer, and were connected so as to feed in parallel into a common network.

This system is now being rapidly superseded by the sub-station system, in which the transformers are banked together, to supply as much as 150 to 200 kilowatts, or even greater power, from one centre.

The evolution is only a natural one, since the inconvenience and trouble of properly examining underground transformers, their fuses and connections, the difficulty of gauging the demand upon individual transformers, and the great increase in the demand for electricity have rendered a safer and more convenient method imperative.

Those who have tried both sub-stations and street transformers will appreciate the advantages of the former; not only are all the switches and fuses available for examination at a moment's notice, but one is also able by inserting demand indicators in the transformer circuits to ascertain whether each transformer is doing its fair share of the load.

All transformers do not bank properly together, not even if they happen to have come from the same maker; the author has experienced trouble in working 20 and 30 kw. transformers together though made by the same firm; the latter would take a considerable overload before the former were more than half loaded. The probability is that if these two transformers had been placed close together underground the 30 kw. transformer would have eventually given out, whereas a demand indicator, so easily inserted in a sub-station, showed up the trouble immediately and prevented mischief.

Wherever possible sub-stations should be above ground, or at any rate easily accessible, and there should always be a lamp fixed with its switch close to the entrance. If proper care is taken in the

design of the switch gear the sub-station can be made absolutely safe. The author's practice is to have no high tension metal exposed, and to furnish a rubber mat and rubber gloves for use in each building; and in order to provide for the continuity of supply, every sub-station is served by two high tension cables.

Where the demand is too scattered to warrant the expense of sub-stations, pillar boxes may be conveniently used. In these pillar boxes, which are about the same size as an ordinary post office letter box, are arranged the fuses and the rest of the gear controlling the transformers; other switch gear may be added if thought desirable. In Southport one of these boxes contains a high tension switch controlling a main feeder, two high tension switch fuses for protecting the transformers, low tension links dividing the street distributing main, and two low tension fuses for the transformer; an earthing device is also included. The transformer is sunk in the ground in a cast-iron case by the side of the pillar box. These pillar boxes can also conveniently be used for containing switches for arc or incandescent lighting.

In alternating current working the distributing cables as well as the high tension feeders, are usually concentric, frequently being laid on the solid system. One of the most glaring defects in the past has been the omission of disconnecting boxes; in a neighbourhood where the demand is great disconnecting boxes should be used very freely, every 100 yards or so, thus inconveniencing as few consumers as possible when the supply is cut off in order to make connections, or for testing. The writer has lately heard of a modern station supplying by means of house transformers only, where there was not a single disconnecting switch outside the generating station; to connect a consumer the whole works had to be shut down.

Where concentric cables are used for distribution it is customary to make the cable dead before making a joint; it is advisable to do so, though not absolutely necessary. In continuous current systems supplying on the two or three-wire system with single cables, it is considered advisable by some engineers to only make connections when the cables are dead; this is the case in Liverpool and probably elsewhere.

Until comparatively lately, service cables from concentric distributors were frequently twin; there seems to be nothing to recommend this system now that such excellent concentric terminal boxes are available; the system should be concentric throughout, or not at all.

The cost of connecting consumers is very heavy, and appears to vary in a remarkable degree in different towns. Thus, according to the returns published by the Municipal Electrical Association, the average cost of connecting a consumer at Hanley, inclusive of meter, joint, cable, &c., is £6, while at Huddersfield, what is presumably the same work, costs £15. In the same returns the cost at Southport of a connection ranks as a good second to Huddersfield with £14 10s., but by the use of a similar, though cheaper joint box to that previously used, and by the increase in the number of 200-volt connections, this sum has now been reduced to an average of about £11 14s. 6d., made up as follows:—

	£	s.	d.
Twenty feet of cable, at 1s. 6d.	1	10	0
One joint box, complete with compound	1	10	0
One house terminal box		17	6
One recording meter	5	0	0
One demand indicator	2	0	0
One meter board for mounting meter, &c. ...		2	0
Opening and making good ground, men's time, tiles, flags, and sundries		15	0
	£11	14	6

The average charge for similar work for gas service is £4 to £4 10s. The interest and sinking fund at 6 per cent. on £11 14s. 6d. is 14s., so that until the cost of services is very materially reduced, it will not pay to supply quite small houses, since even if every house in a street in a poor neighbourhood were connected, the total annual capital charges per consumer could hardly amount to less than 30s. to 40s., which is considerably more than the ordinary artisan pays for all his lighting.

It might be added that at Southport the practice is to put in service cables up to 60 feet in length, and to supply meters, without any charge to the consumer; the author thinks this is the only fair and reasonable system, especially as regards the meter, since it is installed in order to inform the undertakers how much they ought to charge the consumer, just as a tradesman furnishes himself with weighing apparatus to weigh the goods he sells to his customers.

Before electric lighting can become universal, meters must be made cheaply and more mechanically; gas meters can be bought for less than £2, and when once fixed in position are frequently left untouched for years; if makers of electrical meters could only offer a similar article the cost of distribution generally would be much reduced.

Although the costs of generation have been brought down to a figure which was only dreamt of 10 years ago, and the limit of economy in that direction is seemingly almost reached, reduction in the sale price of electricity is barred by the capital charges, which, in many stations, equal, and in some largely exceed the cost of working, *e.g.*: At Southport the total working costs are 1·45d., which, it is hoped, will be still farther reduced; the capital charges, on the other hand, are 1·44d. per unit sold, and are not likely to decrease for the next two or three years at any rate.

It should therefore be the aim of every engineer to keep down the capital invested to the lowest limits consistent with economical and efficient working, and instead of paying large sums in aid of the rates, to build up a substantial reserve fund, out of which to replace obsolete machinery, and so prevent the capital being watered.

COMBINED LIGHTING AND TRACTION WORKS.

By John H. Rider, A.M.I.C.E., M.I.E.E.

Borough Electrical Engineer, Plymouth.

The writer feels that no apology is needed for again bringing the subject of combined lighting and traction works before this Association. Since his 1896 paper much attention has been given to it in various quarters. This city has taken its share in the discussion, and recent events in Glasgow and Manchester will be familiar to most of you.

It may be interesting, in the first place, to notice what has already been done, or, at least, decided upon in this country, in those towns where the local authority owns either both the electric lighting and the tramway undertakings, or one of them.

1. Local authority owning both undertakings:—

Glasgow	separate works	
Huddersfield	"	"
Hull	"	"
Leeds	"	"
Sheffield	"	" 5
Bolton	combined works	
Blackburn	"	"
Blackpool	"	"
Bradford	"	"
Halifax	"	"
Liverpool	"	"
Manchester	"	"
Plymouth	"	"
Southampton	"	"
Wolverhampton	"	" 10

2. Local authority owning lighting works; tramways owned by company:—

Brighton	combined works	
Devonport	"	" 2
Bristol	separate works	
Coventry	"	"
Dublin	"	" 3

3. Local authority owning tramways; lighting works owned by company:—

Dover	combined works 1

4. Company owning both undertakings:—

Cork	combined works 1

The above lists are complete so far as the writer's information goes. It will be seen from them that out of 22 towns 14 have decided upon combined lighting and traction works. Where the local authority owns both undertakings, combined works have a majority of 2 to 1, and in the single instance where a company is supplying electricity for lighting and tramways, *it is doing so from the same works.* In two cases the tramway company is buying current from the lighting works of the corporation, and in one case the corporation is buying current for its tramways from the lighting company. At Leeds and Sheffield the lighting works were purchased by the corporation from a company, and the corporation had decided upon its tramway works before the transfer had taken place.

The arguments which have been brought against combined works have been many. They may be summed up in the following, viz.:—

(*a*) That the natures of the tramway and lighting demands are so different, and the output for tramway purposes so large compared to that for lighting, that the two undertakings should be separate.

(*b*) That a combined lighting and traction works cannot produce current for tramway purposes as cheaply as can the separate tramway works.

(*c*) That the importance of an uninterrupted tramway service is so great, that the tramway should not be dependent upon any outside source for its power.

Free discussion on these points can only be productive of good results. If combined stations be right in principle, then we should do all in our power to increase their number. If they be wrong, then it will be to the advantage of all for separate works to be established.

An electricity works, whether for lighting, or tramways, or both, consists essentially of two distinct departments, viz.:—one for steam producing, and the other for steam using or electricity producing. In considering the effect of a combined lighting and traction load upon any works, both of these departments must be taken into account. In the average English town the lighting load is very small indeed throughout the day, quickly rising to a high maximum when darkness comes on, then more slowly falling off till midnight, and keeping at a low level until the next evening. The changes in the load are fairly gradual, giving time for the starting of additional engines and dynamos as the demand increases, but necessitating the full number of boilers being kept under steam during the 24 hours.

The tramway load is of a different character. It comes on at about 6 o'clock in the morning, and maintains a fairly even *average* right up to 11 or 12 o'clock at night, when it ceases until the next morning. The changes in the load are very excessive and sudden, particularly when only a few cars are in use, so that while enough plant has to be kept running to meet the maximum demand, the

average load may not be greater than one-half of the maximum. If the steam producing plant be of the Lancashire type, with good steam storage, it may be worked at an economical rate all the time, but the electricity producing plant would be working inefficiently.

In a combined lighting and traction works, the steam producing plant and the steam piping should be common to the two services, and for at least 18 hours out of the day the lighting load would only make a very small addition to the total load. But for several hours the lighting load would be heavy, and would overlap the traction load. Unless some other source of supply were provided, additional steam and electricity producing plant would be required for this short time, to be standing idle with large losses during the rest of the day.

Accumulators offer a ready way out of the difficulty. The writer endeavoured to show in a paper before this Association last year that not only would they reduce the amount of tramway plant, but they would enable the same engines to be used for both lighting and traction at the same time, they would take the overlapping of the loads during the evening, and they would make it possible to have a nearly constant output for the whole of the plant during the twenty-four hours. How constant would depend upon the relative maxima of the lighting and tramway loads, but in any case the plant need not be called upon to do more than the maximum of either of the loads, whichever may be the greater, and not the sum of them.

It has been said that these arguments are all very well for small works, having only half a dozen cars running, but that it would not be possible to use accumulators in the manner suggested when there are, say, from 50 to 100 cars to deal with. The writer would ask, "Why not?" Are not large batteries possible? and are they not more likely to be more economical than small ones? Batteries are in use to-day of considerably greater size than were used 10 years ago, and the demand would quickly create the supply.

In a traction works accumulators would be of great service; but they are at their best in a combined lighting and traction works, where their discharge could be used to take the overlapping of the loads.

The tramway output can easily be much greater than the lighting output, not because the maximum load is greater, but because the tramway load continues for such a long time. The tramway plant may be much smaller than the lighting plant, and yet generate from 5 to 10 times as many units during the day. Because the tramway output is very great is no argument against either the use of accumulators or a combined works.

Without accumulators the combined lighting and traction works must have nearly as much plant as though the works were separate, and the only saving would be that one set of buildings and one staff would be required instead of two. The cost of production would certainly be much lower than in a purely lighting works, but it is doubtful whether it could be brought as low as in a works which had only a traction load to deal with.

With accumulators, however, the case would be different. The amount of plant would be reduced, the efficiency of the boilers, piping, and engines would be brought as high as it would be possible to get it, and the combined works could produce current as cheaply as any separate works.

Even where the lighting works have offered to sell current for tramway purposes as cheaply as the tramways could produce it themselves, a great point has been sometimes made of the "divided responsibility," and the difficulties the tramways would be in, in case of an interruption in the supply. Can any reasonable man affirm that there is any more likelihood of a breakdown when the current is produced in a combined works than when it comes from a separate station? Is not a failure of the lighting plant of far more serious moment than the temporary stoppage of the tramways? And may not the engineers, who are accustomed to keep up the lighting supply from one year's end to another, be relied upon to maintain the tramway supply?

In concluding this short paper, the writer would ask those corporations who own electricity works, and who are now considering the adoption of electricity as a motive power for their tramways, to look at the matter in a broad spirit. There should be one electricity works for the town, supplying current for lighting, tramways, and anything else for which current may be used. The tramway department should provide its own lines, the rolling stock, and the overhead (or underground) electrical equipment. The Electricity Department should feed into the overhead wires of the tramways, just as into the wiring of any building. All current should be supplied on the same terms, whether to the tramways, to public lighting, or to private consumers. But the terms should be on the "Brighton" system, with the initial price at a maximum, but for as short a period as possible, and the second price as low as could be managed. Each class of consumer would then be charged at rates in accordance with his use of the supply, and the "long hour" demand of the tramways would result in a very low net charge per unit.

THE ANNUAL DINNER.

The annual dinner of the Association was held on Thursday evening at the Royal Hotel, College Green. There was a large company, and, in the absence of the president, Mr. Faraday Proctor, the chair was occupied by the vice-president, Mr. J. H. Rider. Among those present were the Lord Mayor of Bristol, Messrs. S. Tryon and C. B. Billing (Town Councillors), M. Robinson (Rugby), J. Vesey Brown (Lincoln), C. H. Wordingham (Manchester), Prof. Ryan, Rev. Charles Clark, Dr. E. H. Cook, and Mr. W. H. Wise (clerk, sanitary authority).

At the conclusion of the dinner the CHAIRMAN read letters of apology and regret at absence from several gentlemen, and said he was sure they all regretted very much the absence of the president, Mr. Faraday Proctor, and Mr. George Pearson, both of whom were detained in London. Letters had also been received from Sir W. H. Preece, K.C.B., from the president of the Institution of Civil Engineers, from Mr. Alexander Siemens, and the Mayor of Cheltenham (Alderman Norman).

Proposing the toast of "The Queen," the CHAIRMAN said he hoped Her Majesty would live long enough to make every mayor into a lord mayor, and every electrical engineer into a K.C.B.

The CHAIRMAN next submitted the toast of "The Right Honourable the Lord Mayor and the Corporation of the City and County of Bristol." He said Bristol had played an important part in the history of the country, and from Bristol had gone out men of great fame and ability. He would like to say that they as an Association appreciated to the utmost extent the kind reception the Lord Mayor and the Corporation had given them, and they appreciated very highly the presence of his lordship with them that night. Their Association was an exceedingly young one, and they should be very proud that it had been honoured as it had during that visit to Bristol. As a son of an old freeman of Bristol he knew something about the city and its history, and he could say that the Bristol of to-day was vastly different from the Bristol of 16 years ago when he left it. It had gone on with leaps and bounds. The docks, railway, tramway and other means of transit were immensely improved. He was sure that during the term of office of the present Lord Mayor the city would go on progressing. He trusted the time might come when Bristol would again become the second port in the kingdom.

The LORD MAYOR, in response, said the only sad note in the proceedings that evening was this horrible Gas Bill which was keeping their President and Mr. Pearson away from them. He thought they might be sure there were two miserable men in London that night, Mr. Proctor and Mr. Geo. Pearson. Reference had been made by the proposer of the toast to the city of Bristol. Well, he might say, for those who lived in Bristol, that they were somewhat content with their lot. Take it altogether, it was a very useful, jolly sort of place to live in, and he thought some of the visitors had come to that conclusion, because they took every advantage after finishing their business, of visiting the beautiful suburbs. He perfectly agreed that they were wise in getting as much healthy enjoyment as possible, and in not taxing their brains too much. The Corporation did its best for the city and the citizens. In conclusion, his Lordship expressed the hope that the Association might spend a profitable and enjoyable time in the city and carry away with them many pleasant memories of their visit.

Mr. VESEY BROWN proposed the toast of "Scientific Institutions," and remarked that first of all in the list there was the Institution of Civil Engineers, which was gradually becoming more alive to the position of the electrical student, and was devoting some portion of its bi-annual congress to matters which concerned him. Then there was the Institution of Electrical Engineers, and those who had been members of it for some years knew its history, and would always look back with gratitude to the days when they went on Thursday evenings to hear Mr. Crompton on the advantages of continuous currents, or Prof. Forbes, or someone else, on some equally interesting subject. Following the Institution of Electrical Engineers had come the well-known Northern Society of Electrical Engineers. The county of Lancashire had a large number of people engaged in electrical work, and they felt they were bound to band together in order not to lose touch with one another, or the industry in which they were engaged. They were trying to wipe out what he might call the babyhood of the industry, and bring people more on the level of the electricity of to day. He begged to couple with the toast the name of Mr. Ferranti, who had done more than anyone in that room to bring electricity up to the level upon which it now stood. He himself had had the good fortune to begin his electrical training under that gentleman, and he owed his position entirely to the training he got in the old days some 13 years ago in the Grosvenor Gallery installation.

Mr. FERRANTI rose with great diffidence in the absence of Sir William Preece, whose absence they all regretted, for no one could tell them the details of science and lead them into its fairy land as he could. For his own part, unfortunately, this was a subject upon which he could say very little. He was proud to have been privileged to have had a great deal to do with the practical application of scientific truths which had been discovered and promulgated by able scientists, who were always working for progress.

Mr. MARK ROBINSON submitted the toast of "The Municipal Electrical Association." It was, he said, an important toast, and deserved some preparation, and he regretted that Mr. Siemens was not there that evening to do justice to it. There was in their hands at the present time a very important function. To them was entrusted more than to anyone else the development of what was going to be the greatest mechanical industry of the country. The responsibility for that rested upon electrical engineers and upon members of corporation electrical committees, who were more directly responsible for their action. As one engaged in the manufacture of electrical apparatus, he knew how much depended upon the common sense which might be applied to specifications, and the laying out of machinery by engineers in charge. He knew also how manufacturing firms had been helped by the great common sense brought to bear by electrical engineers, and how, by the gentlemanly way in which they treated it, they had raised this branch to a very high plane. It was fortunate for the future importance of the industry that this had been so. He could only say that the great importance of the Association was recognised by all who had to work with it. In the future, municipal action was going to take a very leading part in many things, perhaps too much so, but, at any rate, it would be a leading part. He would couple with the toast the name of Mr. Wordingham.

Mr. WORDINGHAM (Manchester) a past president of the Association, in replying, said they were much indebted to the Corporation of Bristol for the splendid reception they had received. It was his first visit to the West Country, and it was certainly a revelation of what

hospitality could be, but they must not forget that in the kindness of their friends lay a certain amount of danger. They must not lay themselves as an association open to the reproach of going away for a four days' picnic, or even four half-days' picnic. Hitherto they had striven hard to turn to profitable account the time devoted to the Association at their annual conventions. He did not say they were not doing the same thing now, but they must not carry enjoyment too far or next year they would, perhaps, be having nothing but hospitality and no convention. Municipalities had been referred to, and the present was a time when they were on their trial. There had been made upon municipalities a most savage attack, and that attack was wholly unwarranted and unjustifiable. At the same time there could be no doubt that municipalities were destined to play a great part in the development of electrical engineering, but he did think they should draw the line at manufacturing. He really thought, however, that in this respect a bogey had been raised, for he did not believe any electrical committee of any municipality ever had the slightest intention of manufacturing. There was no reason, as far as he saw, why manufacturers and some of the electrical papers should so attack municipalities. The electrical problems tackled by municipalities had been tackled in a thoroughly sound scientific and engineering spirit. Instead of it being a reproach to be a municipal engineer, it was a thing to be proud of. He said without fe r of contradiction that municipal engineers would stand comparison in every shape and way with companies' engineers, and he ventured to say also that municipal committees would stand comparison with boards of directors both as regards intelligence and a desire to make their undertaking a success, and also in their freedom from corruption. He meant to say it was true municipal committees might have temptation of a kind, but, after all, were company directors and promoters in a position to throw stones? He thought not. It was difficult to say anything new about their Association, but he could say one thing. It was still young, but it continued to be prosperous. It must not be lost sight of, however, that this prosperity depended upon its members, for, hard as the council might work, it could not be a success unless the members took a real interest in its proceedings. Speaking as a past president, he would say that the council welcomed and desired suggestions and criticism from all the members. It was impossible, however, to please everybody. So far the Council had done its best for the Association. It had avoided cliqueism, which was the ruin of any society. Some could point to more than one society which had met with that stumbling block. They had avoided that, and had also endeavoured to avoid setting any dangerous precedent, and to have as much latitude in everything as possible. It was not for him to pass in review what the Association had done, but he would say how grateful they were to the President for the benevolent scheme. He commended it to them, not only to the engineers, but to the representatives of committees, because it could not be too strongly laid down that it was a benevolent, and in no sense a provident society. He would venture to suggest to the gentlemen present that when they went back to their respective towns they would mention the Association and suggest to the members of their committees that they might subscribe to this benevolent fund. He thought they had done rightly in endeavouring to start a fund which would be valuable for some of them when dark days came. Unfortunately, it was not the lot of many of them to have high salaries. They all hoped to see them higher, but it was evident that many who were in subordinate positions would never rise out of them. If they did not feel it now they would in days to come, and it was of these they were thinking. All these things must have a beginning. The magnificent fund of the Institute of Civil Engineers had an income of about £10,000 a year. That fund must have had a beginning, and if theirs was properly supported it would go on, and by-and-bye would be of very real use. He trusted that in the future the Association would do more useful work still.

Dr. Panton (Bolton) proposed "The Visitors."

Prof. Ryan responded in an amusing speech.

"The Press" was submitted by Mr. W. G. Chamen, who coupled with it the name of Mr. T. E. Gatehouse, referring also to the kindness of that gentleman in contributing to the musical programme of the evening.

Mr. Gatehouse, in returning thanks, said the technical Press gladly welcomed such gatherings as these. As might be expected, thoroughly practical papers were read, such as those which were read at the meetings of the National Electric Light Convention in the States, and which were a few years ago of such value to engineers on this side. He would state that, if papers read were subject to comment in the columns of the technical Press, he could only say for himself and colleagues, that this was never done from hostile motives, and only from a desire to get at the truth in the interests of the Association. For many years he had made it his weekly duty to compare the Press of that country with the innumerable exchanges from abroad, and he could say without fear of contradiction that for fearless criticism and honesty of purpose the English technical Press stood without a rival.

During the evening some excellent songs were rendered by members of the company, and a couple of violin solos were played by Mr. T. E. Gatehouse, Mr. Howard Hayman presiding at the piano.

PHYSICAL SOCIETY.

Ordinary Meeting held June 9th, 1899.

Prof. Lodge, President, in the Chair.

The Secretary read a paper by Mr. C. G. Lamb, "On the Distribution of Magnetic Induction in a long Iron Bar."

A Lowmoor iron rod, whose length was 250 times its diameter, was taken, and a B – H curve plotted by ballistic measurements made with a search coil at the centre of the bar. The search coil was then moved along the bar and the distribution of induction was determined for magnetising forces varying from H = ·74 to H = 35·0. Up to fields of 3·35 the induction leaks out more and more quickly as H increases, but above this value the induction tends to keep in more and more. From the curves obtained, the mean induction was deduced, as well as the distance of the resultant pole from the middle of the bar. It is shown that this distance first decreases and then increases with the rise in field strength. According to the ellipsoidal theory it should be constant. The bar was then made into a ring and the B – H curves again determined. From these curves, together with the known relations between B, H, and μ, curves, showing the variation of μ along the bar, were constructed.

The Chairman gave a general explanation of the way the leakage depended upon the permeability in the case of a long iron bar.

A paper "On the Absolute Value of the Freezing Point" was read by Mr. Rose-Innes.

The corrected values of the absolute value of the freezing point determined by Lord Kelvin from experiments on hydrogen air and carbonic acid contain discrepancies amounting to ½rd per cent. between the carbonic acid and the hydrogen, while the separate measurements for carbonic acid agree among themselves to about ½th per cent. Starting with Lord Kelvin's equation for the forcing of a gas through a plug, the author has obtained a formula for the absolute value of the freezing point which can be worked out from the experimental researches of Regnault. The formula is based on the experimental proof by Joule-Kelvin that the ratio between the cooling effect per atmosphere of differential pressure, and the pressure, is constant for all pressures. Applying data from Regnault's experiments to the formula deduced by the author the values of the freezing point are practically the same as those given by Lord Kelvin. Hence it is thought probable that the discrepancies are due to inaccuracies in the experiments of Regnault, which were conducted at constant pressure. The value of the zero calculated from experiments on hydrogen at constant volume made by M. Chappius is, if we treat hydrogen as a perfect gas, 273·034. Applying a thermodynamic correction for the deviation of hydrogen from the laws of a perfect gas, the value of the freezing point becomes 273·19. This figure agrees very closely with the value 273·14 obtained by Lord Kelvin from the constant pressure experiments on air. The correction has only been applied to hydrogen, because in this case it is so small that a large percentage error in its determination has a very small effect upon the absolute value of the freezing point. In constant pressure work the experiments are difficult to carry out and the correction is easily applied, while in constant volume work the experiments are easily performed and the thermodynamic correction is difficult to apply.

Prof. Gray expressed his interest in the manner in which Mr. Rose-Innes had obtained his results without using the experimental data of Joule-Kelvin, and pointed out that Lord Kelvin attached most importance to the results he had obtained for air. It would be useful to have the gas constants redetermined with greater accuracy. The compensating arrangement devised by Prof. Callendar would enable experiments at constant pressure to be carried out satisfactorily.

Dr. Lehfeldt drew attention to the sign of the correction applied by the author, and asked if it should not be negative instead of positive. He pointed out that variation in the specific heat of a gas might affect the formula, and said that Boltzmann had shown that it was impossible to determine an absolute temperature without introducing calorimetric measurements. As Joule-Kelvin had sometimes found positive and sometimes negative values for the cooling effect in the case of hydrogen, large percentage errors might occur in the value of the correction.

Mr. Blakesley asked what the probable error was in the numbers given by Lord Kelvin.

Mr. Watson said that the author had calculated the value of the freezing point from experiments on hydrogen, and had shown that the result agreed closely with the value of the zero deduced by Lord Kelvin from experiments on air. He would like to know what agreement would be got by applying Mr. Rose-Innes's correction to the case of air.

Mr. Rose-Innes, in replying, said he agreed with Prof. Gray that it would be useful to have the constants redetermined. It was only in their early work that Joule-Kelvin observed a cooling effect for hydrogen, the bulk of the experiments giving a heating effect. The sign of the correction depended on the increase or decrease of the effect with temperature and was positive in the case of hydrogen. Regnault has proved experimentally that the value of the specific heat is constant.

POINTS IN ENGINE MAKING.

The basis of much which has been written on the respective merits of English and American machine tool design, has been the fact that in repetition work an American workshop manufactures more cheaply than an English one. Numerous causes have contributed to this. One, and a most important one, has been the action of trades unionism in compelling their members to waste time and in forbidding the employment of one man in attending several automatic tools at one time, even to the extent of compelling him to take the cut off his lathe when using the grindstone. Mr. Orcutt has drawn atten-

tion to these points also in his recent articles in the *Engineering Magazine*, but perhaps his remarks on materials of construction are fully as deserving of note. He particularly emphasised the fact that outside and beyond the undoubtedly bad effects of trades unionism, there were other causes contributing to delay work, and one such was the hardness of our materials of construction. This was in itself quite sufficient to reduce the output of an American machine on English material below what it could do with American material. Peculiarly soft grades of steel, soft cast-iron in which a natural softness has been supplemented by careful pickling of surfaces, all contribute to enable a light built machine to get through a large amount of work. It is not reasonable to suppose that an American lathe on plain work can possibly exceed an English lathe in output. The forms of the two machines, their beds, weight, gearing, and tool slides are all against such a supposition, and Americans themselves acknowledge the superiority of the English type. We are not now speaking of light work and automatic appliances. Granting that output is, as Mr. Orcutt observes, so largely concerned in securing easily worked material on which to operate, and material which has been more carefully prepared as to size than that to which we are accustomed in England, is it not worth considering how far such material ought to be adopted? Is there not a field for some enterprising firm to roll such soft steel, if it is a fact that some shops on this side are bringing it over from America? No doubt some of our readers will have noticed that the parts of American machinery are more easily put out of shape than one should expect from experience of parts of equal size. But after all, such parts might be slightly enlarged for additional strength, did not this perhaps aid as much time to their working as the softness took off. It is probable that many parts might be made of softer material with advantage. At the same time there are limits beyond which the manufacturer will not wisely step. Just at the present time complaints are becoming prevalent as to the softness of certain American productions. Originally soft material is perhaps not responsible for what may rather be due to defective hardening, but the American bicycle is notorious for being soft in the bearings. It is said no one will buy a second American machine. We have referred elsewhere to the softness of American cast-iron as used in steam cylinders. "As hard as can be bored out"—is a phrase which, even though universal in English specifications, has a definite meaning attached to it, and is, on the whole, carried out in the foundry, seems to have no place in the language of the American shops, which appear to work on the assumption that the end and aim of cast-iron is to be rapidly worked.

Now this is an entirely wrong conclusion when carried beyond fair and reasonable limits. English work has been usually designed and made with a view to durability. In the craze for rapidity do not let us forget that rapidity honestly carried out is good, but England's fame and the reputation of her engineers have been built upon the class of work which it is now customary to sneer at as clumsy. We must not altogether accept the outsiders' judgment as to what clumsiness means. Americans call English locomotives clumsy for no other reason than that they differ from American productions. We venture to say that the verdict of any really unprejudiced observer will be very different when American locomotives run side by side with our own. In America the workshop has ruled. Design and material have both been subordinated to the workshop—to the maker rather than to the user. We do not know if any special care has been taken by Mr. Johnson, of the Midland Railway, or by the Baldwin Company, that the cylinder metal of the American locomotives shall be more in accord with English ideas. American stationary engines have this fault of soft cylinders, and it is a serious drawback on many other good qualities. Then, again, there is the placing of the crankshaft of a traction generator between the fly-wheel and the armature, so that all controlling forces must pass through the crank pin. *Engineering News* of New York illustrates the spider of a large railway generator, and remarks that the fly-wheel is attached to it, so that the fluctuation stresses do not pass through the shaft. The practice is good, but if good for large engines it ought to be equally good for small ones. Very common and usual American practice, however, in this line puts the fly-wheel as described above on the wrong side. This, of course, demands double cheek cranks and is not sound practice, because it produces reversal of torsive stresses in the shaft which do not occur when the fly-wheel is between the power and the load. In this latter disposition both the engine and the fly-wheel urge the shaft in one direction. When otherwise placed the acceleration of the fly-wheel produces an opposite stress in the shaft from that produced when the fly-wheel is giving out energy. It may appear to a superficial observer that an engine with fly-wheel on one side and generator on the other is better balanced and more symmetrical than the older side crank engine. This is a very superficial and a layman's view. In fact, such symmetrical engines are anything but good in their stress arrangements. There is room for our own English engine makers to come forward and add very considerable improvements upon the engines provided for traction purposes, even after all the experience the Americans have had in this branch. One of the faults we have pointed out results from the domination of the workshop over the user, durability being sacrificed to ease of manufacture. The other fault is one of design. It shows that the stresses in traction work may not be terrific after all, and it shows, of course, something faulty in the thinking-out of design, for a fly-wheel ought to be near its work when possible.

"Electricity Accounts."—Among the papers read at the annual meeting of the Corporate Treasurers' and Accountants' Institute at Plymouth Guildhall this week was one on "Municipal Electricity Accounts," by Mr. Stevens, the borough accountant of Brighton.

NOTES ON A VISIT TO THE GENERATING STATION OF THE CENTRAL LONDON RAILWAY.

[COMMUNICATED.]

Engines.—The engine house has been very liberally designed, and, consequently, the four 1,000-H.P. steam alternator sets look comparatively small, although they are slow speed. Six sets are to be laid down, and when the line is in operation four will be at work, one turning round and the other being overhauled. Each engine is fitted with a steam separator and steam receiver between the high and low pressure cylinders. The Corliss trip gear is very simple, and the ease with which the hard steel wearing surfaces can be renewed is a special feature.

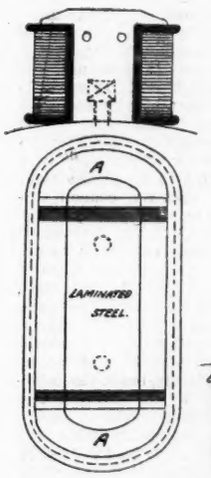


Fig. 1.

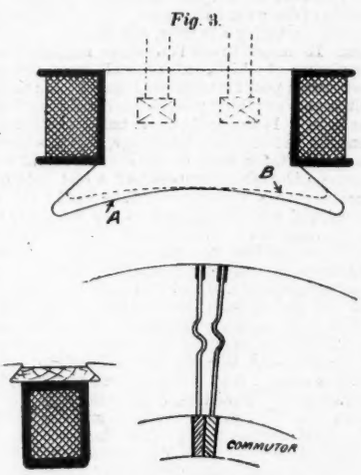


Fig. 3. Fig. 2. Fig. 4.

Alternators.—The three-phase alternators are fine examples of electrical engineering work. The poles are laminated and bolted on to the magnet wheel separately, square recesses being left in the centre of the stampings to take the bolt heads. The winding is of bare copper strip about $1\frac{1}{2}$ inches wide and $\frac{1}{16}$ inch thick, wound on edge Ferranti fashion, adjacent coils being insulated with thin sheet red fibre. In order to enable the copper to bend easily the ends of each pole are fitted with semi-circular gun-metal castings, as shown at A A in fig. 1. The outer surface of the poles is not turned up, but is profiled over to the shape shown in the figure. The armature coils are held in position in the slots by wooden wedges, which are let into detents on each side as shown in fig. 2.

Motors.—The magnet poles to the motors are also laminated, and the method of saturating the pole tips is rather novel. It consists in cutting the plates (which are rather under $\frac{1}{16}$ inch thick) to the shapes marked A and B in fig. 3; this gives each pole tip only one-half the section of iron. There is a coil to each pole, but on account of want of space, the top and bottom coils are smaller than those at the sides. It was noticeable that the teeth of the armature core are carefully machined off at the edges.

Rotary Converters.—In order to allow for expansion and contraction, the uprights to the commutator of the rotary converters are corrugated, as shown in fig. 4. This is rather an old idea, but as uprights have a nasty habit of parting company with the commutator segments, it is as well to take every precaution to guard against accident.

Controller.—The blow-out on the controller is not of the well-known Thomson type with a pair of steel magnets always excited, but consists of a series of solenoids as first introduced by the Walker Company. In this arrangement there is a separate solenoid to each pair of contacts, and the connections are such that it only comes into action when a break is made. The arc is not driven across the contact

as in the old form, but is forced out in a radial direction through openings which are left in the cover. The contact strips are mounted on a massive wooden barrel, the wood of which has been treated to make it non-inflammable. There are four motors on each locomotive, arranged two series, two parallel at starting up, and all in parallel when running full speed.

With the exception of the boilers and economisers all the plant has come over from America, even to the steam and exhaust piping. There are, however, very few Americans on the job. The engine makers (Allis) have sent a representative, and an American is superintending the erection of the Sprague lifts, but with these exceptions all the rest of the staff are British.

In conclusion, the writer must say that he was much struck with the excellent way in which the parts had been packed for shipment.

THE TRANSPORTATION PROBLEM.

An article written by Mr. W. J. Hammer in the *Independent*, of New York, U.S.A., constitutes a concise and interesting *résumé* of the various systems of rapid transit which have been proposed or actually carried into practice. Far ahead of all others comes the trolley system, which has practically eliminated both horse and cable traction from street railway work; the number of electric lines at work in the United States in 1898 was 954—nearly all of which are worked on the overhead trolley system—with 15,672 miles of track, 36,429 motor cars, and 7,914 trailers. In Europe, at that time, there were 248 lines, with 5,734 motor cars; of these no less than 206 are trolley lines, and other 11 are combinations of the trolley with a conduit or storage battery system.

The conduit system, while it is free from the unsightliness of the overhead construction, has been found in practice to suffer more than the latter during stormy weather; nevertheless, Mr. Hammer is of opinion that in many places the trolley will soon be replaced by some form of conduit. Amongst other systems the closed conduit invented by Mr. H. B. Cox is described. This proves to be practically identical with the Lineff system, described in the Electrical Review so long ago as May 9th, 1890.

It is interesting to note that the Chicago-Englewood service of storage battery cars, of which a full account has appeared in our pages, has been discontinued; we ourselves pointed out, in our issue of February, 1898, that the results obtained in the official tests were unfavourable to the prospects of success. It is a matter for regret that this should be the almost invariable fate of the storage system, but there seems to be little room to hope for better things so long as lead and salts of lead form the vital parts of accumulators.

The adoption of electric propulsion on the American elevated railways has become inevitable, on account of the severe competition of surface lines; but the change, so far from being unprofitable, has, in at least one instance, more than trebled the net receipts within a twelvemonth! It is noteworthy that in this instance the Sprague "multiple unit" system was adopted, in which each car is a motor car, and the whole train is controlled from either end. We firmly believe that the London Metropolitan and District Railways will enjoy a similar experience, when they gather courage to make the conversion from steam to electricity.

Transmission of power by means of polyphase currents at high pressure, with step-down transformers and rotary converters in sub-stations, bids fair to become universal practice in large and wide-spreading railway and tramway systems; a 70,000 H.P. plant of this kind is now being installed in New York, while similar installations are already in operation at Chicago, Lewiston and other places. The three-phase system with induction motors is in use at Engelberg, Zermatt, and the Jungfrau, in Switzerland. At Engelberg the two 75-H.P. three-phase motors of the locomotive, when descending steep grades, become generators, and supply power to the other trains; the power returned in this way is sometimes actually in excess of the demand, and has to be dissipated in water resistances!

For extra high speeds, from 60 to 120 miles per hour, the Behr mono-rail system is being tried by the Belgian Government; the experimental line is situated near Brussels, and is 3 miles in length, with steep grades and sharp curves. A single car is used, 60 feet long, 70 tons in weight, and capable of seating 100 passengers; the car is fitted with four electromotors of 200 H.P. each, geared to the driving wheels by special chains. With this car a speed of 83 miles per hour has been attained without inconvenience from vibration, and it is claimed that on a longer line a speed of 120 miles per hour could be reached with perfect safety.

The application of electricity to long-distance railways is not yet considered to be advisable; but, says Mr. Hammer, it is bound to come. No better motor exists than the electromotor for this purpose, with its uniform torque, capability of sustaining overloads, &c.; and with the adoption of electricity will come the possibility of speeds of 125 to 150 miles per hour, combined with comfort and safety.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, *to whom all inquiries should be addressed.*

11,590. "Improved microphonic contact sensitive to both sound and Hertzian waves." S. G. Brown. Dated June 5th.

11,596. "Improvements in the means of insulation of electrical mains and other conductors." P. Cardew. Dated June 5th.

11,646. "Improvements in devices for securing incandescent electric lamps in their sockets." W. Ravene. Dated June 5th. (*Complete*)

11,657. "Apparatus for forming plates of secondary batteries." H. Leitner. Dated June 5th.

11,658. "Appliance for preventing the fraudulent or erroneous changing of glow lamps in electric light installations." Siemens Bros. and Co., Limited. (Siemens & Halske, Aktien Gesellschaft, Germany.) Dated June 5th. (*Complete.*)

11,678. "Improvements in electrolytic apparatus for extracting metals lighter than the electrolyte." W. P. Thompson. (H. Becker, France.) Dated June 5th.

11,679. "Improvements in magnetic apparatus for curative purposes." W. P. Thompson. (T. A. Steffens, Germany.) Dated June 5th.

11,682. "Improvements in electric switches." T. H. Marsh and A. Vandam. Dated June 5th.

11,685. "Improvements in motor cars driven by electrical or other motive power." W. Muller. Dated June 5th. (*Complete.*)

11,693. "Improvements in apparatus for connecting branch circuits to electric mains." Callender's Cable and Construction Company, Limited, and T. O. Callender. Dated June 5th.

11,717. "Improvements in electric batteries." A. E. Hodgson. Dated June 6th.

11,747. "Improvements in telephones, phonographs, and such like apparatus." A. S. Bowley. Dated June 6th.

11,775. "Improvements in dynamo electrical machines and motors." R Holiday. Dated June 6th.

11,776. "Improvements in apparatus for electric traction." H. Dolter. Dated June 6th. (*Complete.*)

11,843. "Improvements in devices for starting electric induction motors." The British Thomson-Houston Company, Limited. (The Union Elektricitäts-Gesellschaft and A. P. Zani, Germany.) Dated June 7th. (*Complete*).

11,879. "Production of chromium oxide by electrolysis." E. G. A. Street. Dated June 7th.

11,880. "Improved portable electrical drilling machine." A. L. Cronbau. Dated June 7th.

11,881. "Electrical apparatus for effecting rotation at a distance." A. L. Cronbau. Dated June 7th.

11,885. "Improvements in controlling apparatus suitable for use with electric motors." H. J. Walker. Dated June 7th. (*Complete.*)

11,901. "Improvements in electrical brush-holders." W. J. Poole. Dated June 8th.

11,930. "An improved electrolytic apparatus." T. M. I Wilhelm and H. Richard. Dated June 8th. (*Complete.*)

11,931. "Electric light saver." W. Cox. Dated June 8th.

11,938. "Improvements in electrically driven sheep shearing or hair clipping machines." G. Bowmar. Dated June 8th.

11,948. "Electric circuit closing devices." F. Wilke. Dated June 8th. (*Complete.*)

11,983. "Improvements in attachments for collectors in electric tramways with slotted conduits." M. H. Smith. Dated June 8th.

11,984. "Improvements in poles for supporting overhead wires in electric tramways." M. H. Smith. Dated June 8th.

11,985. "Improvements in overhead conductors for electric tramways." M. H. Smith. Dated June 8th.

12,056. "Improvements in or connected with conduits for underground electric conductors." J. Y. Johnson. (L. Dreyfus, Germany.) Dated June 9th.

12,085. "Improvements in or relating to apparatus for the reception, transmission and reproduction of telephonic communications." A. J. Boult. (H. H. Burckhardt, Germany.) Dated June 9th.

12,105. "Methods of employing resistance materials for electrical purposes where such materials are in the form of a powder." W. B. Spikins and A. H. Mayes. Dated June 10th.

12,113. "Machine for covering electric wires or cables with strips of fibre." F. L. Sperry and W. James. Dated June 10th. (*Complete.*)

12,114. "Improvements in electrically-driven fans." W. H. Scott. Dated June 10th.

12,131. "An exciting fluid for generating a constant current in primary batteries." R. F. Drury. Dated June 10th.

12,164. "Dynamo-electric generators." J. N. Smith and W. A. Johnson. Dated June 10th. (*Complete.*)

12,165. "Improvements in electric motors." W. J. Still. Dated June 10th.

12,171. "Improvements in galvanic cells." W. E. Case. Dated June 10th. (*Complete*)

12,172. "Improvements in galvanic cells." W. E. Case. Dated June 10th. (*Complete.*)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free,* 9d. (*in stamps*).

1897.

28,458. "Improvements in and relating to electrically-controlled submarine mines." P. C. F. Hoffmann. Dated December 2nd, 1897. Relates to means for regulating the depth of immersion. An electro-motor in a casing is supplied with current from the shore station, and acts through the gearing to rotate a shaft, so as to raise or lower the mine. A ratchet-wheel on the motor shaft is normally engaged by a pawl, but as soon as current passes to the motor, the pawl is withdrawn by the electro-magnet. The casing acts as an anchor to the mine. 4 claims.

28,460. "An improved electrical accumulator." C. Payen. Dated December 2nd, 1897. (Date claimed for patent under Section 103 of Act, May 4th, 1897, being date of first foreign application in Belgium.) The electrodes are in the shape of a grooved or fluted truncated cone or pyramid enclosed in an open-work conductive case, proof against the action of the electrolyte. The electrode may have a central longitudinal orifice, which may be filled with a core of lead. 2 claims.

28,480. "Improvements in or relating to the application of electric propulsion on railways and tramways." L. Vojacek. Dated December 2nd, 1897. Electric railways and tramways with an armature trolley running in a closed conduit and kept in touch with the vehicle by electro-magnets on the latter. Conduits, conductors, switches, collectors, permanent way, insulation.—The closed conduit is built up of a trough section and cover of insulating material, with air and water tight joints. Sectional conductors are placed inside and outside the cover, being electrically connected, and those on the outside surface being placed alternately on opposite sides. The main conductor is preferably placed on the bottom, and is connected to the sectional conductors by the trolley when it is lifted by the magnets on the vehicle. The trolley has an armature body of soft iron with a vertical joint for rounding curves. Wheels bear under the inside sectional conductors, and other wheels bear on the main conductor, the latter wheels being carried by the spring-controlled arms. When the current is broken in the magnet the body drops and causes the brake blocks to bear on the wheels, thereby stopping the trolley. At the same time an audible signal may be caused to sound to indicate the position of the trolley. The construction of this signal is as follows:—A spring serving to drive a train of clockwork which strikes a bell is wound up by a friction-wheel, worm gearing, and bevel gearing, the latter having clutches and a Geneva stop to control the winding. A stop engaging the controlling fan of the clockwork is liberated by a roller when that is raised against the roof of the conduit by the lifting of this alarm mechanism when the body of the trolley falls. The magnets are fixed on the vehicle a fixed distance above the cover of the conduit, and the collecting wheels are depressed by springs. In the conduit lengths of the conductor are pivoted to act as switch tongues, and are operated in one or both directions by one or two electro-magnets placed externally to the conduit and excited automatically or otherwise on the passage of the vehicle. Where the rails cross the conduit, short lengths of insulating material are interposed to avoid short circuiting on to the return circuit. 10 claims.

28,492. "Improvements in variable electrical resistances." W. Robotham. Dated December 2nd, 1897. Liquid resistances for regulating electric currents consist of cells containing sets of stationary parallel plates either vertical or horizontal, into or from the cells conducting liquid is introduced or removed. This may be done automatically by valves connected by springs with a rack geared to a lever which is supported by a spring and carries a core above a regulating solenoid. In a modification, both valves are at the bottom of the resistance cell, one being connected with an adjacent tank, which is kept full of liquid by a ball valve. Liquids of two conductivities may be used in such resistances. A float in the resistance cell may raise a switch lever to short circuit the resistance when the cell is full. The lubricating chamber, made in two parts, is attached to the bearing by a set screw. Oil is conveyed to the surface of the shaft by a chain or equivalent means. The small chamber is filled with packing to prevent the lubricant from escaping. 3 claims.

28,519. "Improvements in electrical tumbler switches." A. Watson. Dated December 3rd, 1897. Relates to detail improvements in tumbler switches for preventing short circuiting, &c. A movable arm pivoted is fitted with an insulating block which is thus interposed between it and the toe of the tumbler lever. A strip of steel may be fitted on the block to take the wear. Stops are embedded in the insulation, or they may be replaced by a metal plate having turned-up ears. The bar has turned-in edges to take in grooves in the insulating block, which is finally secured by the turned-up ends. Instead of a sliding block, a strip of insulating material wrapped around the bar and secured by a clip may be employed. The bearing pin, which passes through suitable ears, is enclosed in an insulating sleeve around which the fly spring is coiled. The terminals, &c., are fitted in a well formed in the base. 3 claims.

28,721. "Improvements in the manufacture of electrical resistances of metal foil." H. Helberger. Dated December 4th, 1897. Relates to electric resistances. A resistance is made by pressing metal foil by a punch into asbestos or other cardboard and removing excess metal. It may be used for heating and other purposes. 1 claim.

28,726. "Improvements in holders for incandescent electric lamps." J. Booth. Dated December 4th, 1897. Holders for incandescent lamps. The casing is made in two parts. One part is provided with an external screw for a cord-grip, two internal projections to prevent rotation of the insulator, and a flange. The other part is attached to the part within the flange, and has an expanded portion, screw-threaded to carry a shade-holding ring. 2 claims.

28,727. "Improvements in insulating blocks connected with holders for incandescent electric lamps." J. Booth. Dated December 4th, 1897. Incandescent lamps, holders for.—The insulating body is made in one piece, of cylindrical form, with an enlarged part. Recesses or projections are provided to engage the casing of the holder, to prevent rotation. A projection extends diametrically across one end of the insulator, and on each side of this round holes are provided to receive cylindrical plunger-holders and contact blocks. These are stepped to fit together, and are secured by screws. 2 claims.

28,728. "Improvements in holders for incandescent electric lamps." J. Booth. Dated December 4th, 1897. Incandescent lamps, holders for.—The case is made in one piece by stamping. Projections are provided to prevent rotation of the insulating body, and a screw thread to hold a cord-grip. 1 claim.

28,729. "Improvements in electrical switches." J. Booth. Dated December 4th, 1897. Electric Switches.—Relates to switches having watertight cases for use on board ship, &c. The case is fitted with bosses in which are secured by nuts bushings to which the metal sheathing of the conductors is soldered. The ends of the conductors are secured to terminals on the base. The contact bar is operated by pins depending from a block connected to the handle. A spring is fitted to give a fly action. The spindle, where it passes through the cover, is fitted with collars to give a watertight joint. 4 claims.

28,800. "Improved electric meter." A. Peloux. Dated December 6th, 1897. Energy Meters.—A motor meter consists of a spindle carrying coils through which the main current, or a proportional current, passes by mercury cups at its ends; these coils rotate within stationary coils through which successively a shunt current is passed to produce a rotating magnetic field, by a brush carried by a spindle moving around a stationary commutator. The spindle is geared to a counter. Its rotation is retarded by an air fan, or by a conducting disc moving in the field of a constant permanent magnet or electro-magnet. The spindle may carry a permanent magnet, or a winding in series with the brush to neutralise the effect of friction. All the coils may be provided with laminated iron cores, in which case the rotary part may be surrounded by a conducting cylinder to effect the retardation. In a three-wire meter, the spindle carries two coils to which two main currents are conveyed by four mercury cups. In a modification, flat main current coils are carried on opposite sides of the spindle in a plane at right angles to it, moving between pairs of stationary coils. The brush may be carried by a wheel geared to the motor spindle, so as to rotate about a commutator placed parallel to the spindle. Such meters are independent of external magnets. 3 claims.

28,943. "Improvements in or connected with electric driving gear." E. Corbens, Dr. E. Noah and Dr. G. Noah. Dated December 7th, 1897. Electric-motors, vehicles. Motors:—Both the armature and the field-magnets are made revoluble, and each is geared to one of the two shafts to be driven, which may, therefore, run at different speeds. The invention is applicable for motor road vehicles. 3 claims.